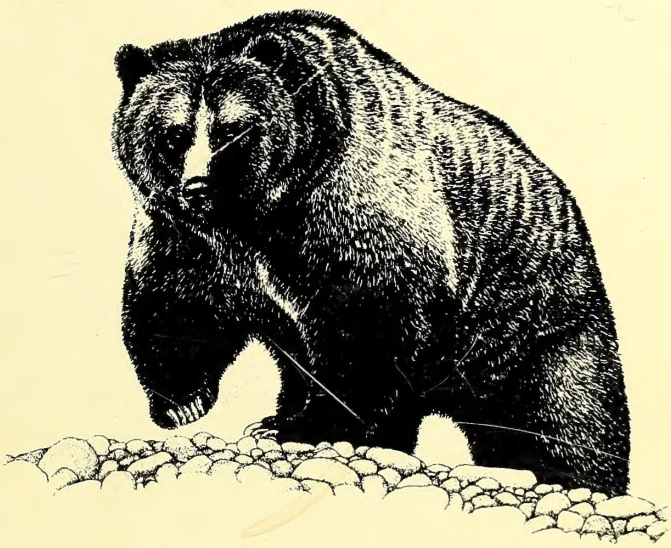
GRIZZLY BEAR COMPENDIUM



Sponsored by The Interagency Grizzly Bear Committee

1987

MT Dept. Fish, Wildlife & Parks

Bureau of Indian Affairs

FOREWORD

The Interagency Grizzly Bear Committee (IGBC), established in 1983, plays a major role in the conservation and management of the grizzly. The IGBC is composed of Regional Directors of the Fish and Wildlife Service and National Park Service, three Forest Service Regional Foresters, Montana State Director of the Bureau of Land Management, and State wildlife agency directors or representatives from the States of Idaho, Montana, Washington, and Wyoming. The primary objective of the IGBC is to serve as the coordinating mechanism for research and management related to the grizzly bear recovery program in the contiguous 48 United States.

The Grizzly Bear Compendium was developed in order to assemble all available information on the biology and management of the grizzly bear in North America. The Compendium was designed to be a source document for grizzly bear managers, researchers, and students. The Compendium has a format designed to facilitate review of all available information on any subject area of interest regarding grizzly bears. It contains both published and unpublished information from all North American sources. It also includes a complete reference list along with a detailed narrative summary by topic, which covers all aspects of grizzly bear biology and management. It is hoped that the Compendium will be used to enhance the management of the grizzly bear and thereby to assure its continued existence as a wild species.

GRIZZLY BEAR COMPENDIUM

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Interagency Grizzly Bear Committee

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Size
Growth Rates and Patterns
Pelage and Molt
Hematology
Digestive System
Genetic Considerations
Nutritional Requirements
Activity Patterns
Intraspecific Behavior
Courtship and Copulation
Age/Sex
Population Densities
Population Regulation
Impacts From Livestock and Other Agricultural Impacts
Industrial Impacts
Road and Highway Impacts
Aircraft Impacts
Garbage Impacts
Recreational Impacts
Grizzly Bear-Black Bear Relationships
Grizzly Bear-Wolf Relationships
Grizzly Bears and Other Mammals
Biogeographic Considerations
Human Attitudes
Aversive Conditioning, Deterrents and Attractants
Population Augmentation
Relocation of Nuisance Bears
Reintroduction of Grizzlies into Former Range
Methods for Estimating Population Size and Trends

Canfield, Jodie (Consultant) and A.L. Harting

Home Range and Movements
Reproductive Rates

Mace, Richard D., Consultant

Food Habits Summary
Cover
Approaches to Habitat Classification and Mapping
Grizzly Bear Ecosystems

Patnode, Kathleen A., Institute for Wildlife Research

Sensory Systems
Parasites, Diseases and Other Natural Mortality Factors
Denning

Patnode, Kathleen A. and M.N. LeFranc, Jr.

Distribution

Sugg, William C., III, Institute for Wildlife Research

Skull and Dentition
Body Temperature, Respiration and Heart Rate

Moss, Mary Beth, Institute for Wildlife Research

Recreation
Garbage

LeFranc, Maurice N., Jr., Institute for Wildlife Research

Introduction
Harvest Strategies

Moss, Mary Beth and M.N. LeFranc, Jr.

Administrative Management Guidelines
Timber
Roads
Grazing
Subdivision
Fire
Mining, Oil and Gas Development
Aircraft
Cumulative Effects Analysis
Outfitters

Editors

Maurice N. LeFranc, Jr.
Mary Beth Moss
Kathleen A. Patnode
William C. Sugg, III

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX LIST

INTRODUCTION

On 1 September 1975, the grizzly bear was classified as a threatened species south of the Canadian border under provisions of the Endangered Species Act. The grizzly bear met the criteria for threatened status for the following reasons: 1) there exists both present and threatened future destruction and/or modification of its habitat; 2) there is at present a loss or potential loss of bears by illegal killing and by control actions involving grizzly bears threatening humans or killing livestock; 3) critical data are lacking on grizzly habitat conditions, carrying capacity, population estimations, annual reproduction, mortality and population trends; and, 4) some existing populations appear to be isolated from each other and cannot be reinforced by movements from other areas (Servheen 1982).

The grizzly bear in the lower 48 states presently numbers from 600-800 individuals (U.S. Fish and Wildlife Service 1982); approximately 75% of this population occurs in Montana. Historically, grizzly bears were distributed from the Pacific Ocean to the Mississippi River and from Mexico to the Arctic Circle. In the last century, grizzly bears disappeared from Texas, Kansas, Arizona, New Mexico, Oregon, Utah, California, North Dakota, South Dakota and perhaps Colorado and Washington (Craighead et al. 1974). At present, management is based on six recognized grizzly bear ecosystems, distributed over wilderness and park areas, and large national forests in the mountainous regions of Idaho, Montana and Wyoming (U.S. Fish and Wildlife Service 1982). Specific recovery plans have been approved for three of these areas: Yellowstone Grizzly Bear Ecosystem, Northern Continental Divide Grizzly Bear Ecosystem and the Cabinet-Yaak Grizzly Bear Ecosystem.

The grizzly bear in the conterminous 48 states is vulnerable to many threats, the greatest of which are habitat modification or loss, and human-caused direct mortality. Resource management activities, which include logging; geothermal, mineral and energy development; water impoundments; and livestock grazing, all lead to the destruction or modification of grizzly habitat (Knight 1977, U.S. Fish and Wildlife Service 1982). Man's activities not only lead to habitat loss, but activities such as subdivision development, commercial recreational development, livestock grazing, sport hunting and recreation increase the likelihood of bear/human conflicts and may lead to ultimate destruction of the bear (Knight 1977, Craighead et al. 1982, U.S. Fish and Wildlife Service 1982).

Craighead (1977) discussed management of grizzly bear populations, by stating; "To perpetuate the species and to expand the population where possible, as directed by the Endangered Species Act of 1973, federal and state agencies must develop guidelines and management programs that will alleviate direct competition between bears and man for the same geographic space and habitat." Agencies and the scientific community working with this species and its habitat must cooperate in developing this management plan.

In 1982, a Grizzly Bear Recovery Plan was prepared and approved. The specific objectives of the Plan (U.S. Fish and Wildlife Service 1982) are to:

1. Identify grizzly bear population goals that represent species recovery in measurable and quantifiable terms for the several regions that were determined to have suitable habitat for such populations, and to provide a data base that will allow informed decisions.
2. Identify population and habitat limiting factors that account for current populations existing at levels requiring threatened status under ESA.
3. Identify specific management measures needed to remove population limiting factors that will allow the populations to increase or sustain themselves at levels identified in the recovery goals.
4. Establish recovery of at least three populations in three distinct grizzly bear ecosystems in order to delist the species in the conterminous 48 states.

Management must be based on the biology and life history of the grizzly bear, *incorporate all available scientific information* and take into account the social, political and economic context in which the species functions. To achieve the stated management goals for the grizzly bear, *a thorough review of research, management and policy information was identified as a priority need.* This information must be produced and published in a form readily available to researchers, managers and decision makers. Without this information, sound management decisions will be impossible. Production of the *Compendium on Grizzly Bears in North America* will hopefully accomplish this.

Completion of this project required a thorough review of all information available on the grizzly bear (both published and unpublished) in North America. Identification of previously compiled bibliographies (e.g., Tracy et al. 1982) on grizzly bears aided in assuring thoroughness of the *Compendium*. Information collection involved acquisition of literature from, but not limited to, the following sources:

1. computerized literature search services
2. library research
3. requests for information to grizzly researchers
4. state and provincial agencies; particularly Alaska, Wyoming, Washington, Idaho, Alberta, British Columbia, Northwest Territories, Yukon (reports, memorandums, etc.)
5. federal agencies; particularly U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service, Bureau of Land Mangement (reports, memorandums, etc.)
6. private conservation organizations.

Concurrent with identification and collection of the literature was reviewing and keywording each reference. An initial list of subject keywords was developed (Appendix B) and revised after review by the COTR. This list was used to assign subject keywords to describe each article.

The second task necessary for the completion of this project was the development of software for organizing and compiling references. Software was produced to achieve the following objectives:

1. information storage and retrieval
2. edit capabilities
3. sorting by author, source, keyword and geographicindicator
4. produce a master list of citations alphabetized by author and assigned a master number
5. produce a list of keywords referenced by master number
6. produce a chapter of geographic indicators referenced by master number
7. produce a dictionary of keywords
8. print the above information in a format suitable for distribution.

Following literature collection and subsequent keywording, detailed narrataive summaries were prepared. Summaries were compiled from a review of the collected keyworded references and include:

1. introduction to the topic
2. review of past research
3. summary of biological statistics
4. regional variation relative to the topic
5. age/sex variation relative to the topic
6. management implications.

Acknowledgements

As in any project of this scope, numerous individuals contributed to its success. Principally we would like to acknowledge the assistance of Dr. Chris Servheen, Grizzly Bear Recovery Coordinator, U.S.F.&W.S., Technical Representative on this project, who provided direction and advice. Dr. Fred Dean who laid much of the groundwork with his previous bibliographic efforts, provided additional assistance and much appreciated cooperation.

Several other individuals took an active part in the completion of this project by providing access to their literature collections and advice and assistance on the project. They are G. Contreras, R. Harris, J. Hechtel, S. Herrero, C. Hunt, C. Jonkel, K. Kendall, R. Knight, C. Martinka, S. Stringham, J. Weaver and P. Zager.

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Several individuals provided direct assistance on the project including J. Canfield, A. Gaski, L. Harting and J. Hechtel. Their contributions are much appreciated.

In addition to staff of the National Wildlife Federation's Institute for Wildlife Research the following Federation personnel contributed to the completion of this project; S.D. Miller, Vice President, Research, Education and Development; M. Kiser, A. Thomas and J. Trussell, Data Processing; and, S. Levy, Librarian. Dr. J.D. Hair, Executive Vice President and W.W. Howard, Senior Vice President, Conservation Programs provided the support necessary to complete this project.

L.G. Muse, Administrative Assistant, Institute for Wildlife Research, provided the necessary support in keying citations, typing drafts and producing the final document.

Final acknowledgement goes to the narrative authors, primarily Albert Harting. His persistance in locatng documents, coding and keywording references, and writing narratives is central to this effort. Rick Mace authored several narratives on grizzly habitat and provided advice on others. Jodie Canfield assisted in the compilation of several tables and narratives.

Mary Beth Moss, Kathy Patnode and Will Sugg, Institute for Wildlife Research authored several narratives and provided essential asistance in editing and compiling the *Compendium*.

We appreciate the efforts of all involved, and apologize to anyone we may have neglected to mention.

DISTRIBUTION

HISTORIC RANGE

Fossil evidence and historic accounts indicate that the grizzly bear originally occurred throughout most of central and western North America with concentrations in the Rocky Mountains and major river valleys (Fig. 1) (Craighead and Craighead 1967, Dood et al. 1986). Opinions differ as to the exact location of the eastern boundary. Most of the evidence supports a north-south edge between Manitoba and Ontario proceeding south through Minnesota, Nebraska, Kansas, Oklahoma and Texas and continuing down into the Mexican highlands (Bjorklund 1978, U.S. Fish and Wildlife Service 1982a). However, scattered records exist east of this boundary in Ontario, Quebec, Newfoundland, Ohio and Kentucky suggesting a broader prehistoric distribution (Elton 1954, Guilday 1968).

With man's westward expansion, the grizzly's range continued to recede. Extirpation from border states occurred in the following sequence: Texas (1890), North Dakota (1897), California (1922), Utah (1923), Oregon (1931), New Mexico (1933), Arizona (1935) and Colorado (1979) (U.S. Fish and Wildlife Service 1982, Dood et al. 1986a).

CURRENT DISTRIBUTION: LOWER 48

Today, remnant populations are managed in 6 ecosystems comprised of federal, state and private wilderness in Wyoming, Idaho, Montana and Washington. In addition, transient or relict populations were thought to possibly exist into the late 1970s in California and Colorado, (Craighead and Craighead 1967) and more recently in northern Mexico (Jonkel et al. 1977). Population densities vary greatly between ecosystems, as well as seasonally with 4 of the 6 experiencing exchange with contiguous Canadian populations. The grizzly bear ecosystems currently exist as described below (Fig 2 & 3) (U.S. Fish and Wildlife Service 1982a, Dood et al. 1986).

Yellowstone

Includes Yellowstone and Grand Teton National Parks, John D. Rockefeller Memorial Parkway, portions of Bridger-Teton, Custer, Gallatin, Shoshone and Targhee National Forests andparcels of Bureau of Land Management (BLM), state and private lands in Montana, Wyoming and Idaho.

Northern Continental Divide

Includes Glacier National Park, portions of Flathead and Blackfeet Indian Reservations; portions of Flathead, Helena, Kootenai, Lewis and Clark and Lolo National Forests and parcels of BLM, state and private lands in Montana. Contiguous with Canadian Rockies ecosystem.

Cabinet/Yaak

Includes portions of Panhandle, Kootenai and Lolo National Forests; Cabinet Wilderness Area and state and private lands in Montana and Idaho. Contiguous with Canadian Rockies ecosystem.

Selkirk Mountains

Includes portions of Panhandle and Colville National Forests and private and state lands in Idaho and Washington. Contiguous with Canadian Rockies ecosystem.

North Cascades

Includes portions of North Cascades National Park, Ross Lake National Recreation Area, Mount Baker and Okanogaan National Forests. Contiguous with Interior B.C. ecosystem.

Selway/Bitterroot

Includes portions of Clearwater, Bitterroot and Nez Perce National Forests and is centered in the Selway-Bitterroot Wilderness Area.

CANADA

Currently, self-perpetuating populations occur in the wilderness areas of Alberta, British Columbia, Northwest Territories and Yukon Territory (Fig. 4). In addition, some evidence indicates relict populations may exist in Saskatchewan and possibly Manitoba (Pearson 1977, Cumbaa and Sciscenti 1978).

With Alaska, the Yukon Territory and British Columbia share the largest proportion of the remaining grizzly bear populations in North America. Relatively dense populations occur in the parks and wilderness areas of the northwest coastal, northern interior and Rocky Mountain ranges (Fig. 5) (British Columbia Fish and Wildlife Branch 1979a, Alberta Fish and Wildlife 1984). Grizzly bears are managed within 10 ecosystems, 4 of which are contiguous with U.S. populations (Fig. 6) (Pearson 1977. S. Herrero pers. commun).

Coastal B.C.

Covers the coastal mountains of British Columbia from Vancouver to southeastern Alaska including the coastal islands with the exception of Vancouver Island.

Interior B.C.

Covers central British Columbia from the U.S. border north to Williston Lake and includes portions of the North Cascades, Columbia, Omineca and Skeena Mountain ranges, as well as numerous lakes, drainages and provincial parks. Contiguous with North Cascades ecosystem of U.S.

Canadian Rockies

Covers the Rocky Mountains in both Alberta and British Columbia from the U.S. border northwest and includes portions of Waterton Lakes, Kootenay, Yoho, Banff, Glacier and Jasper National Parks; Willmore Wilderness Park; Rocky Mountain Forest Reserve and numerous provincial parks. Contiguous with three U.S. ecosystems: Northern Continental Divide, Cabinet/Yaak and Selkirk Mountains.

Boreal Forest

Covers the northwestern quarter of Alberta and the northeastern corner of British Columbia and includes the Caribou Mountains, and Buffalo Head Hills and the Peace River drainage.

Barren Ground

Encompasses a broad band across the Northwest Territories from the Hudson Bay to the Mackenzie River and includes Great Bear Lake, Dubawnt Lake and a myriad of smaller lakes and drainages.

Canadian Arctic

Covers both the Yukon and Northwest Territories within the Arctic Circle from the Alaskan border east to Coronation Gulf and includes Richardson Mountains, Melville Hills, Tuktoyaktuk and Parry Peninsulas and Richards Island. Contiguous with Arctic Alaska ecosystem.

Northern Interior

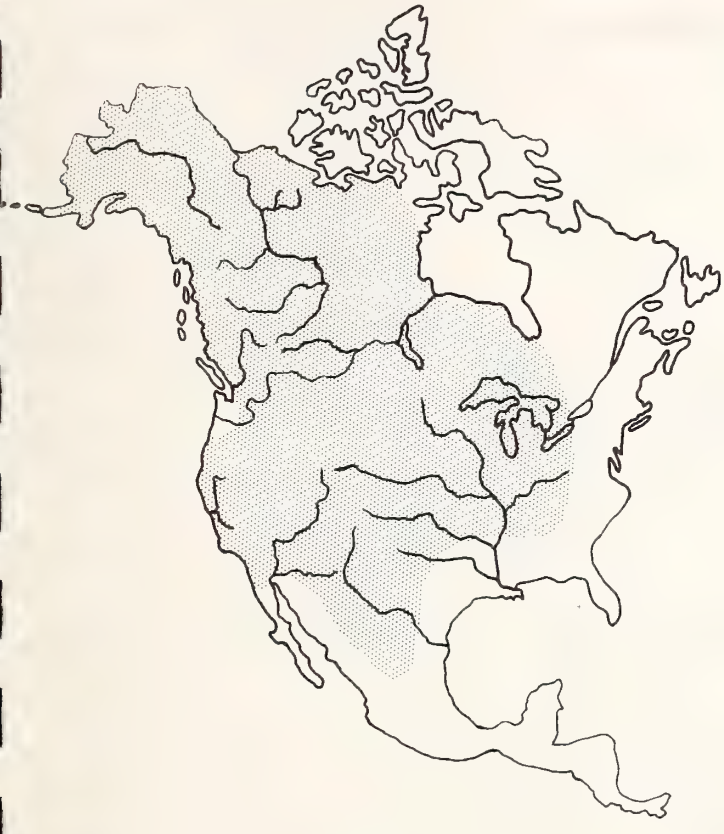
Encompasses the Casia and Stikine Mountains in northcentral British Columbia, the Mackenzie Mountains of the Northwest Territories and all of the Yukon Territory up to the Arctic Circle with the exception of the extreme southwest corner of province. Contiguous with Interior Alaska ecosystem.

ALASKA

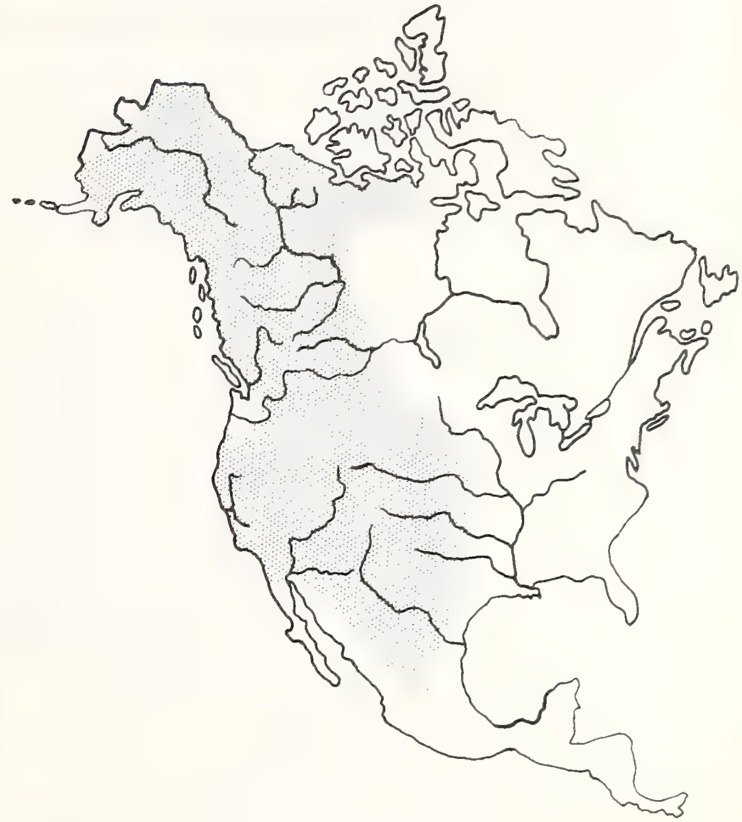
Alaskan grizzly bear distribution has undergone little alteration from its historic range. Only in areas surrounding human population centers has development encroached upon original habitat (Fig. 7) (Alaska Dept. of Fish and Game 1976).

The bears occur throughout the state with the following exceptions. No populations exist on some islands in southeastern Alaska, on the Aleutians beyond Unimak Island or on the islands of Prince William Sound, as well as in the Yukon-Kuskokwin Delta region (Anonymous 1980). Densities vary considerably with southeastern Alaska, the Kodiak Archipelago and the Alaska Peninsula having the highest concentrations and the Arctic the lowest (Fig. 8) (Anonymous 1980).

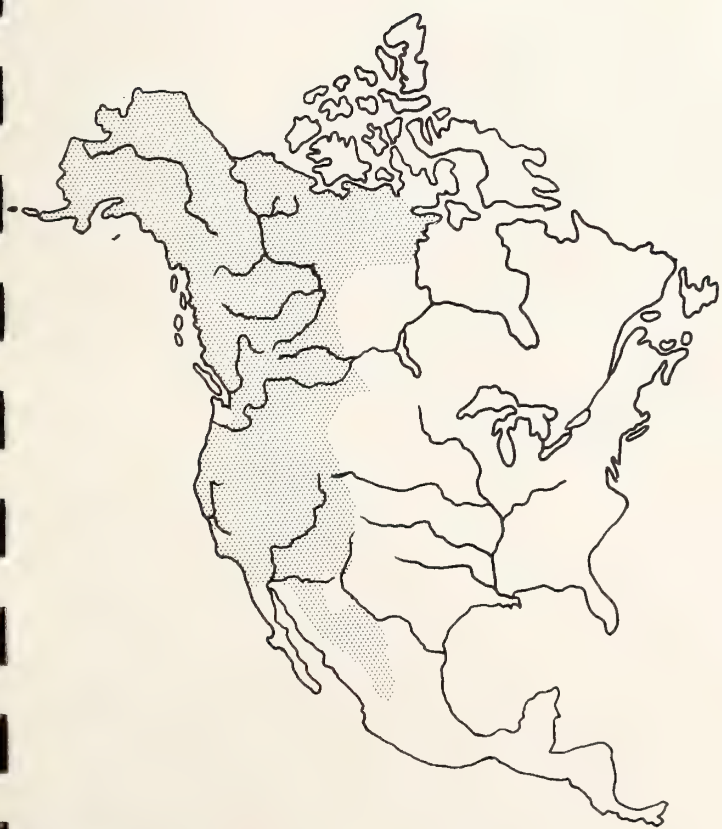
Figure 1. Historic Grizzly Bear Distribution.



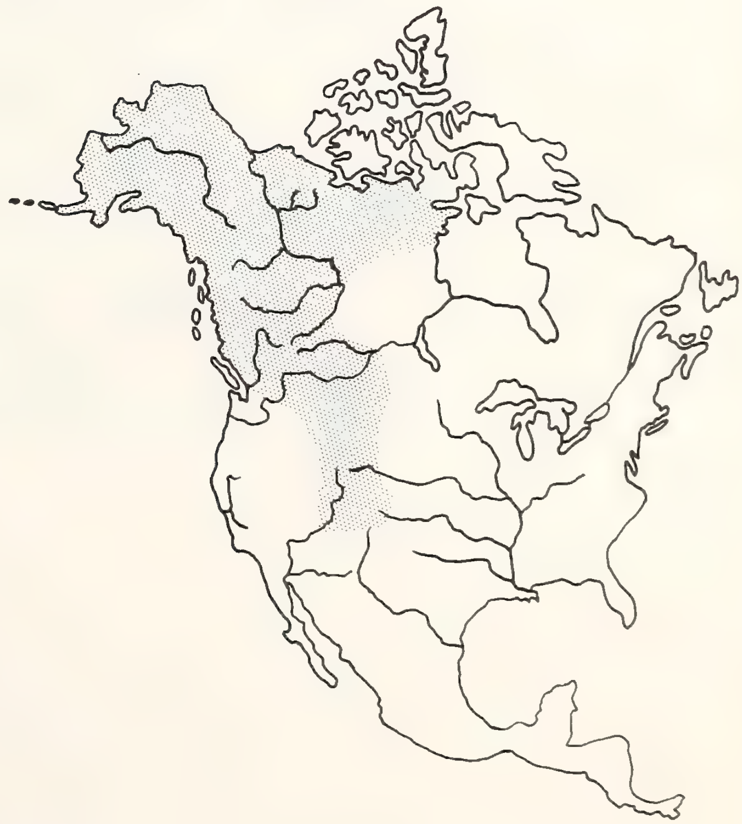
Early Holocene



Late Holocene



1900s



1950s

Figure 2. Grizzly Bear Ecosystems in the Lower 48 States.

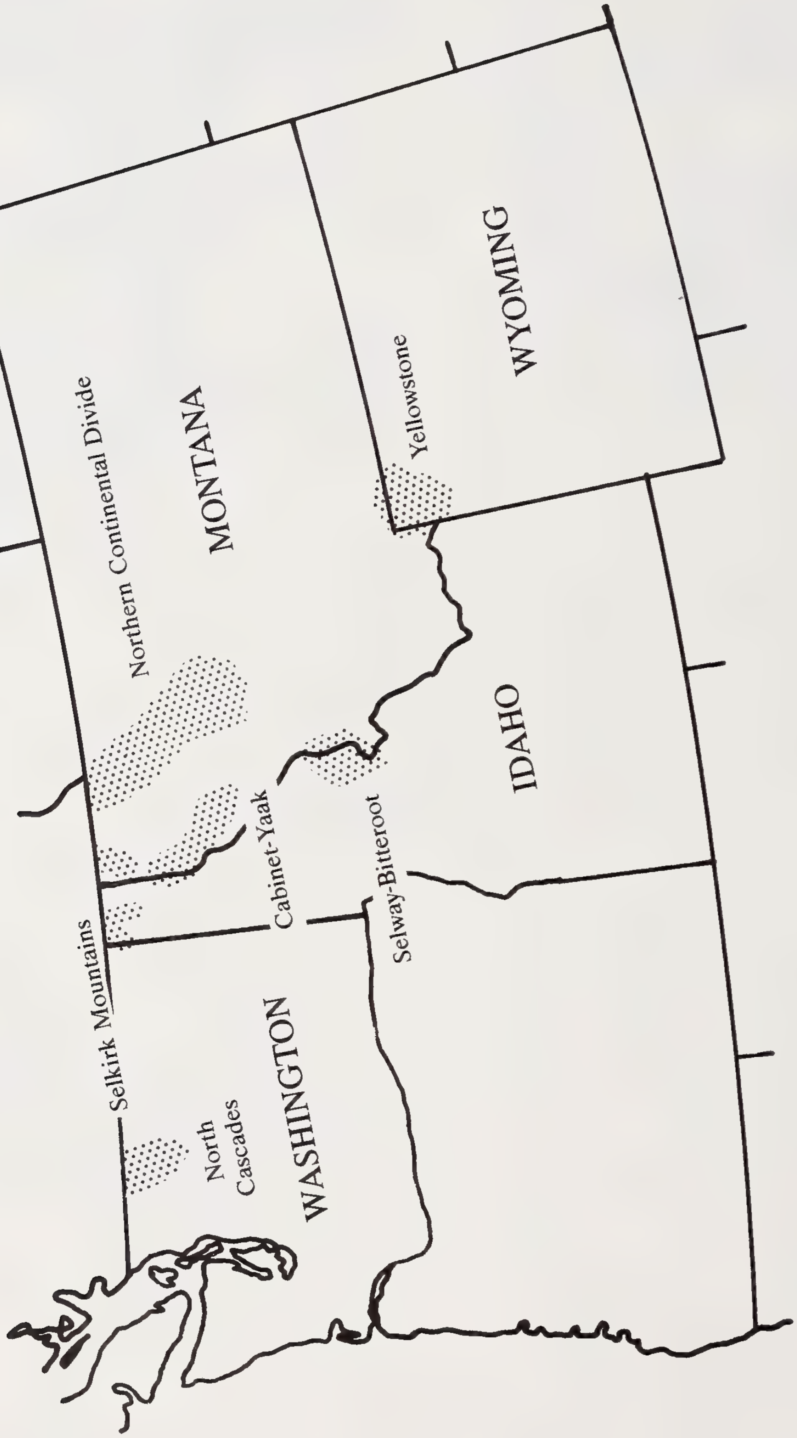


Figure 3. Grizzly Bear Ecosystems and Management Areas in the Lower 48 States.

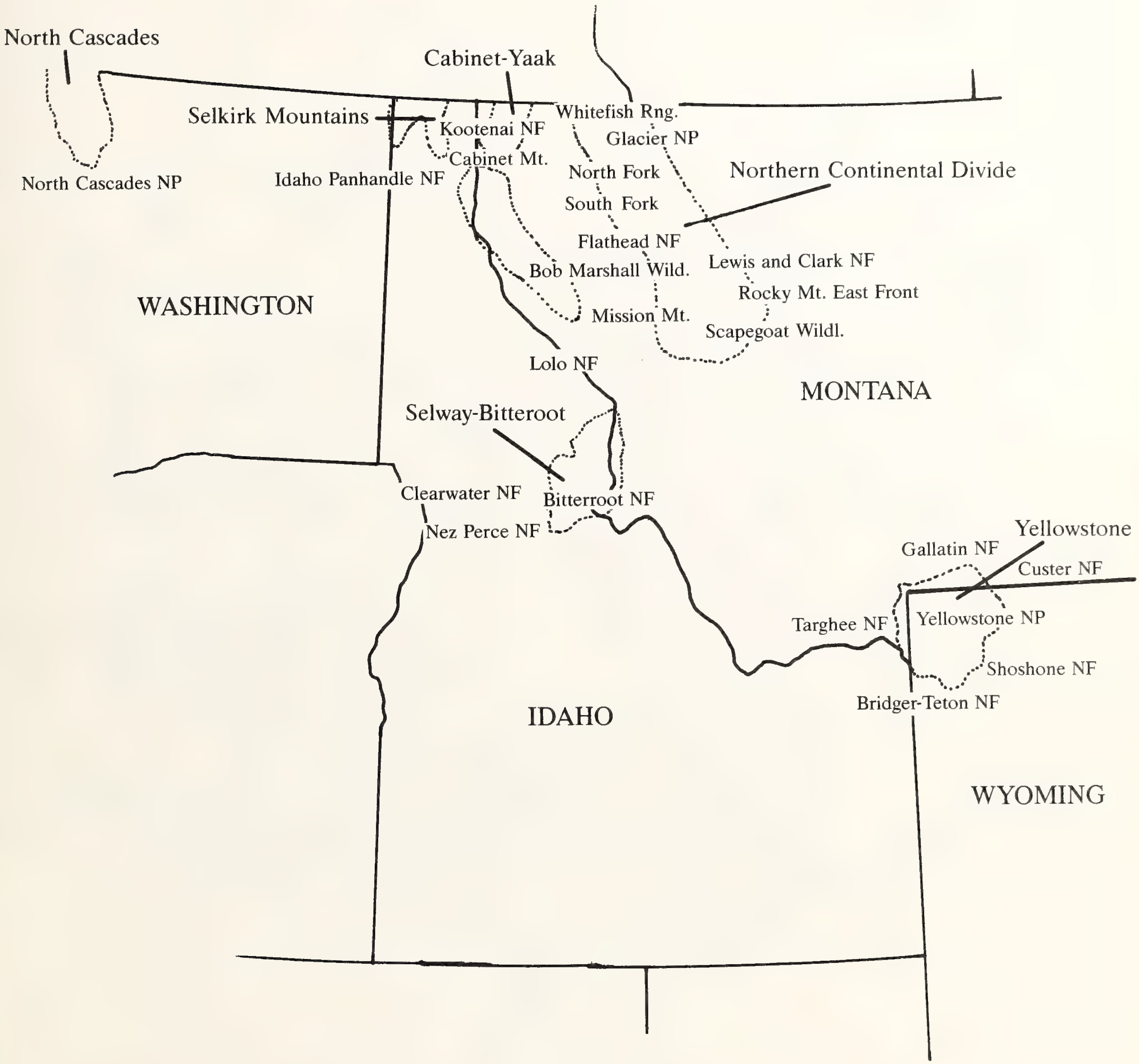


Figure 4. Grizzly Bear Distribution in Canada.

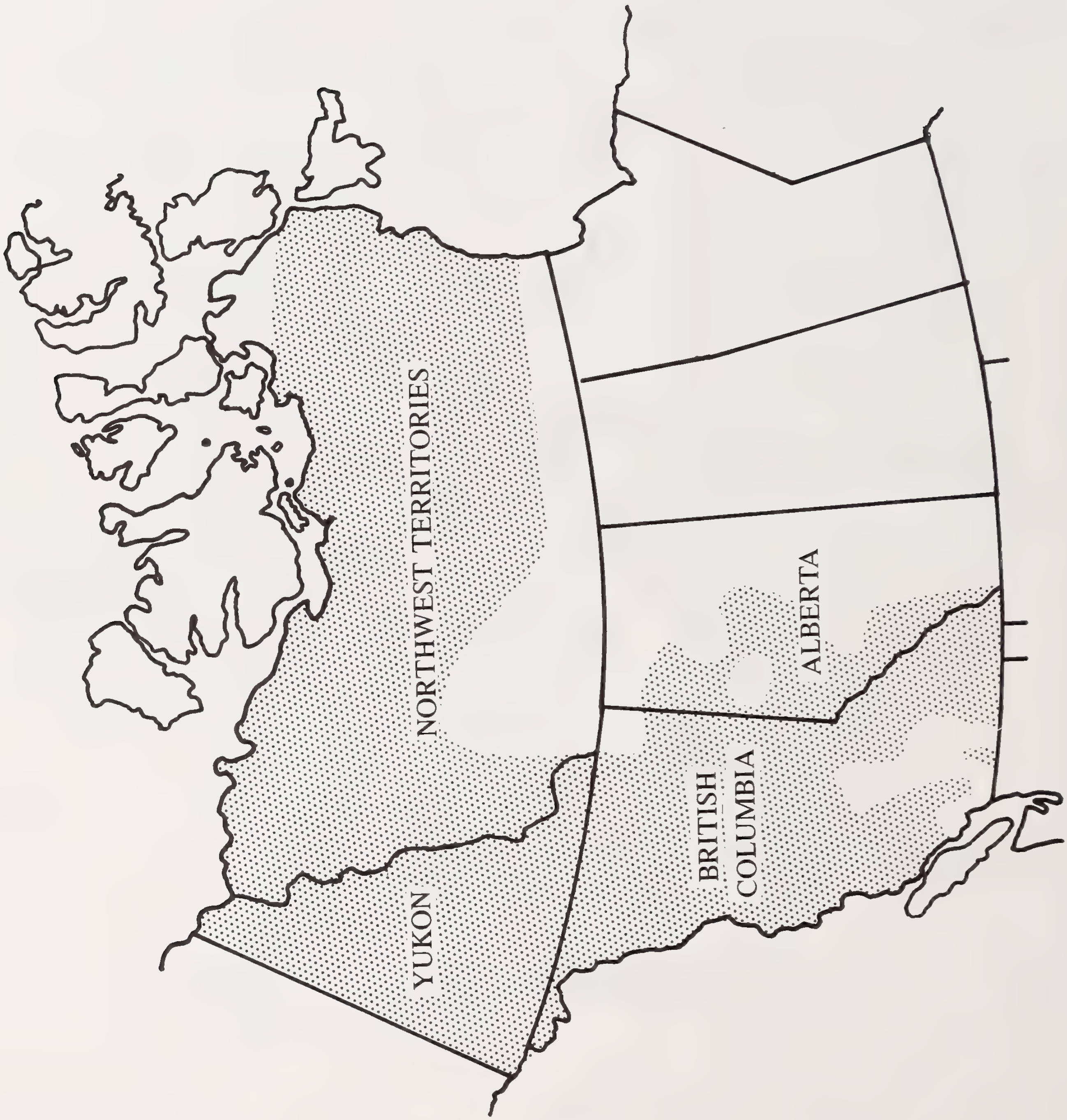


Figure 5. Grizzly Bear Management Areas in Canada.

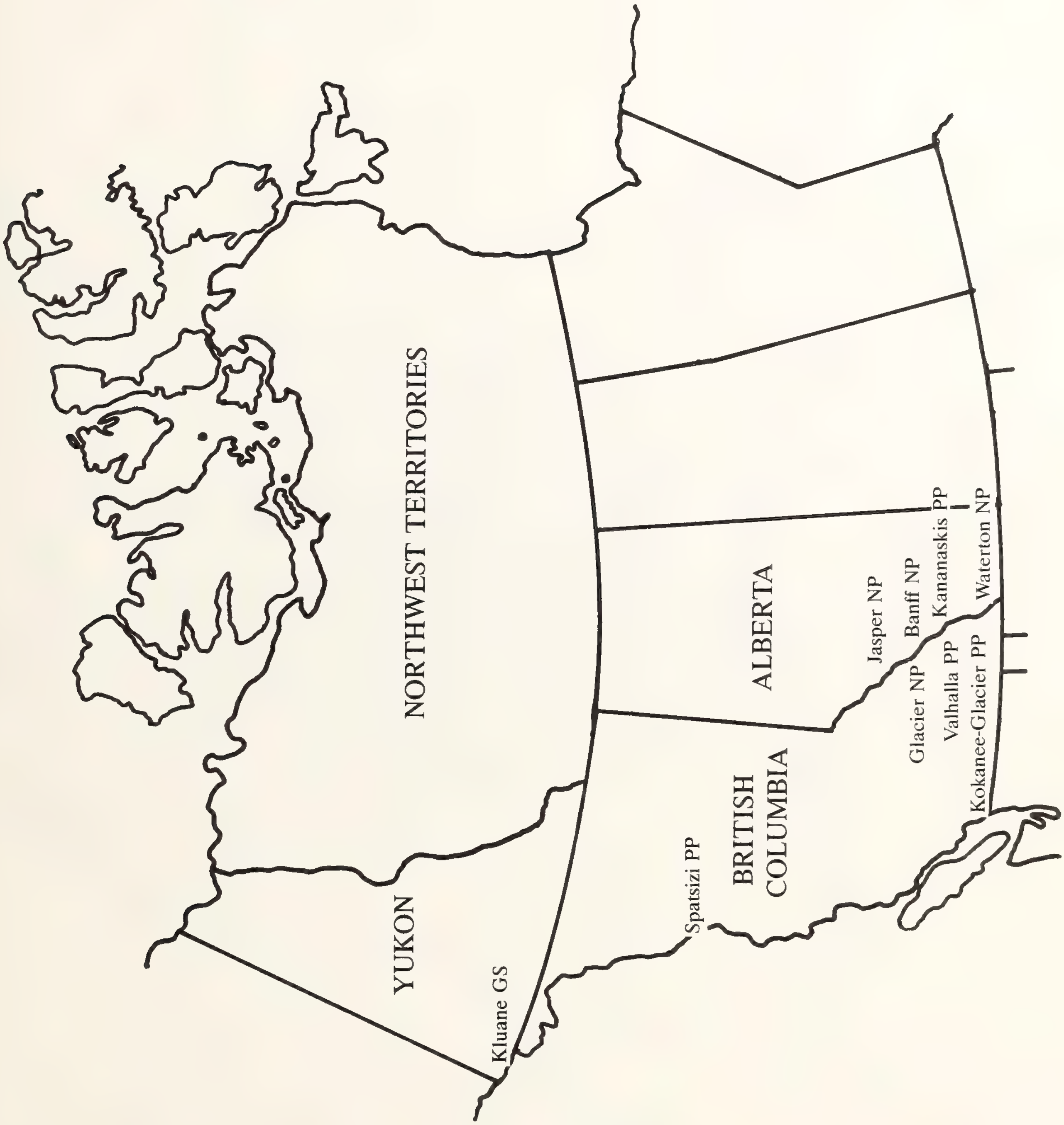


Figure 6. Grizzly Bear Ecosystems in Canada.

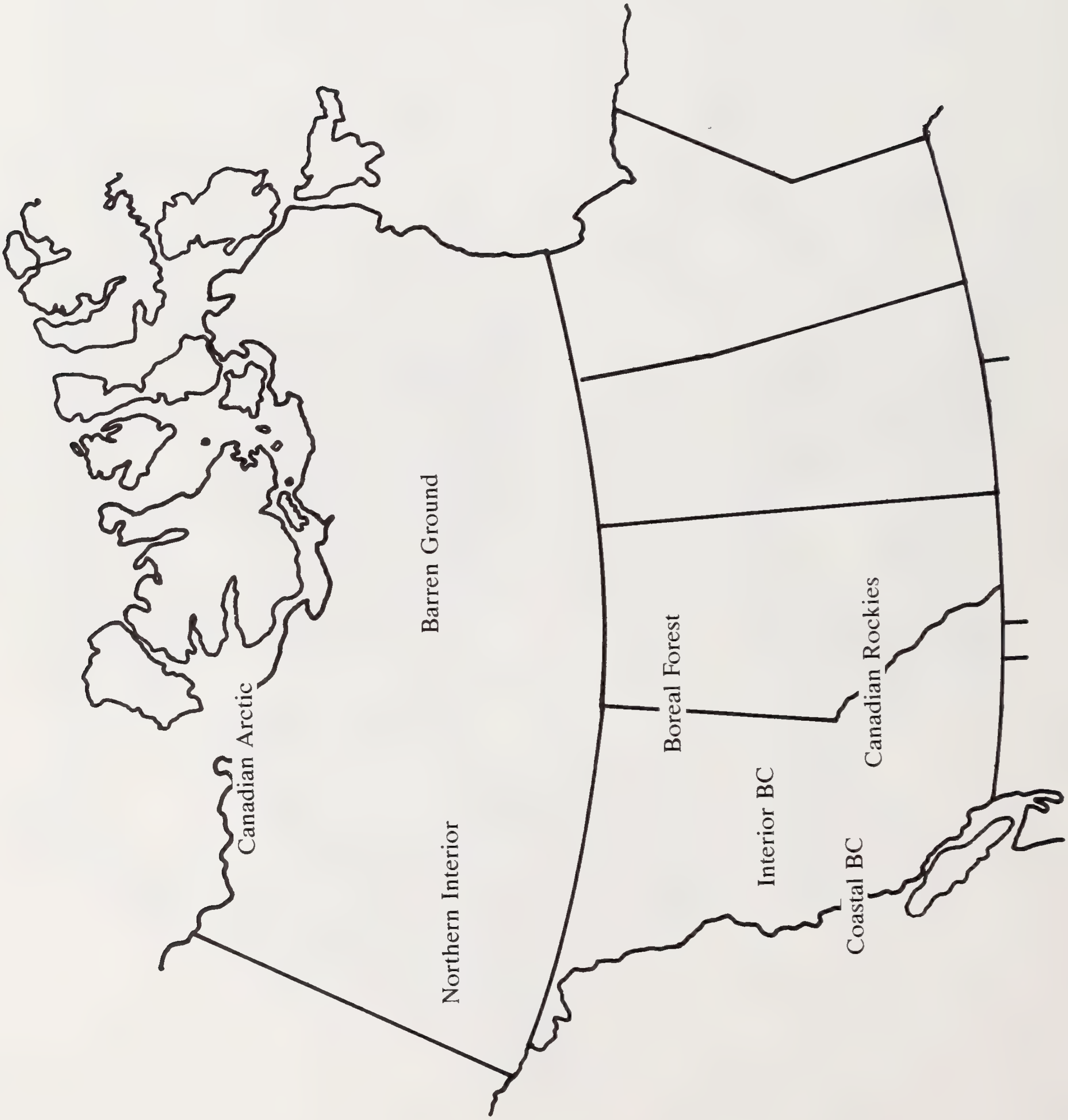


Figure 7. Grizzly Bear Distribution in Alaska.

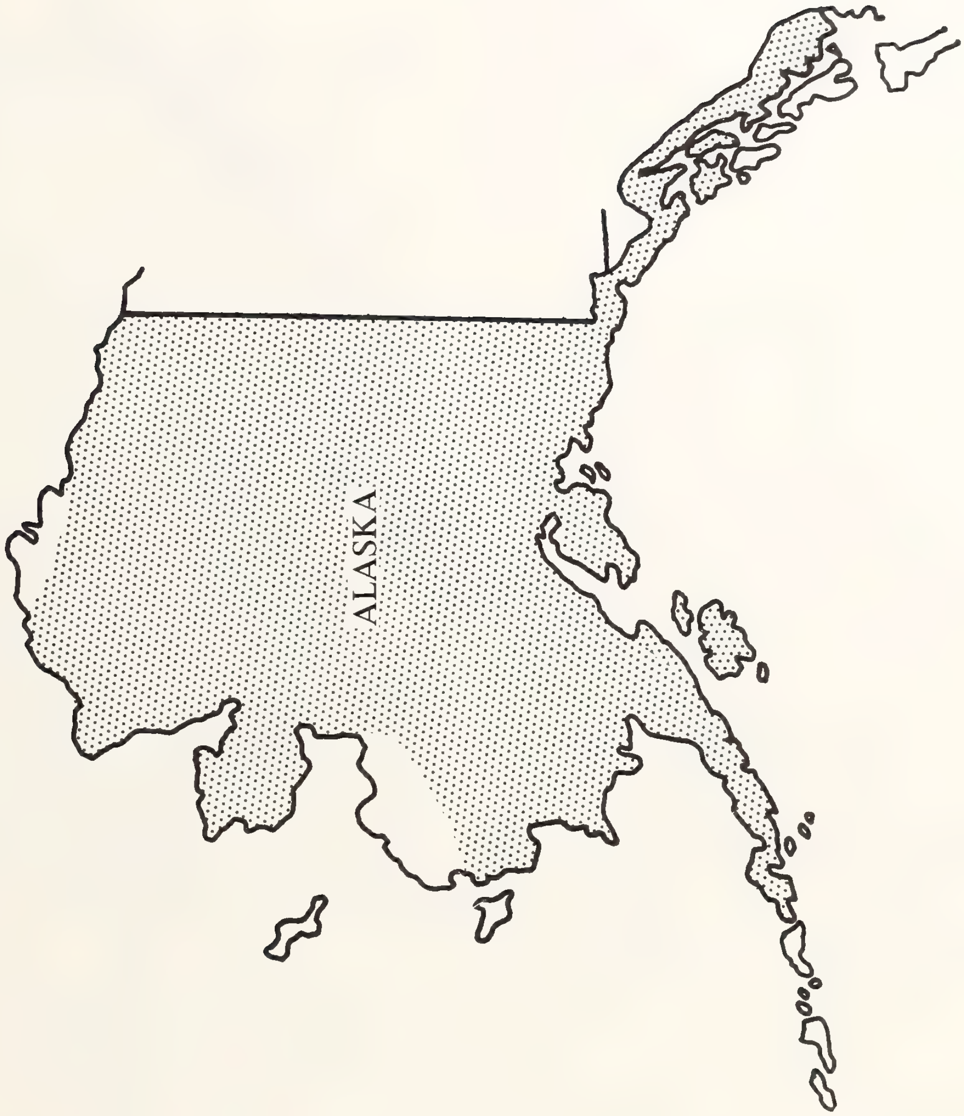
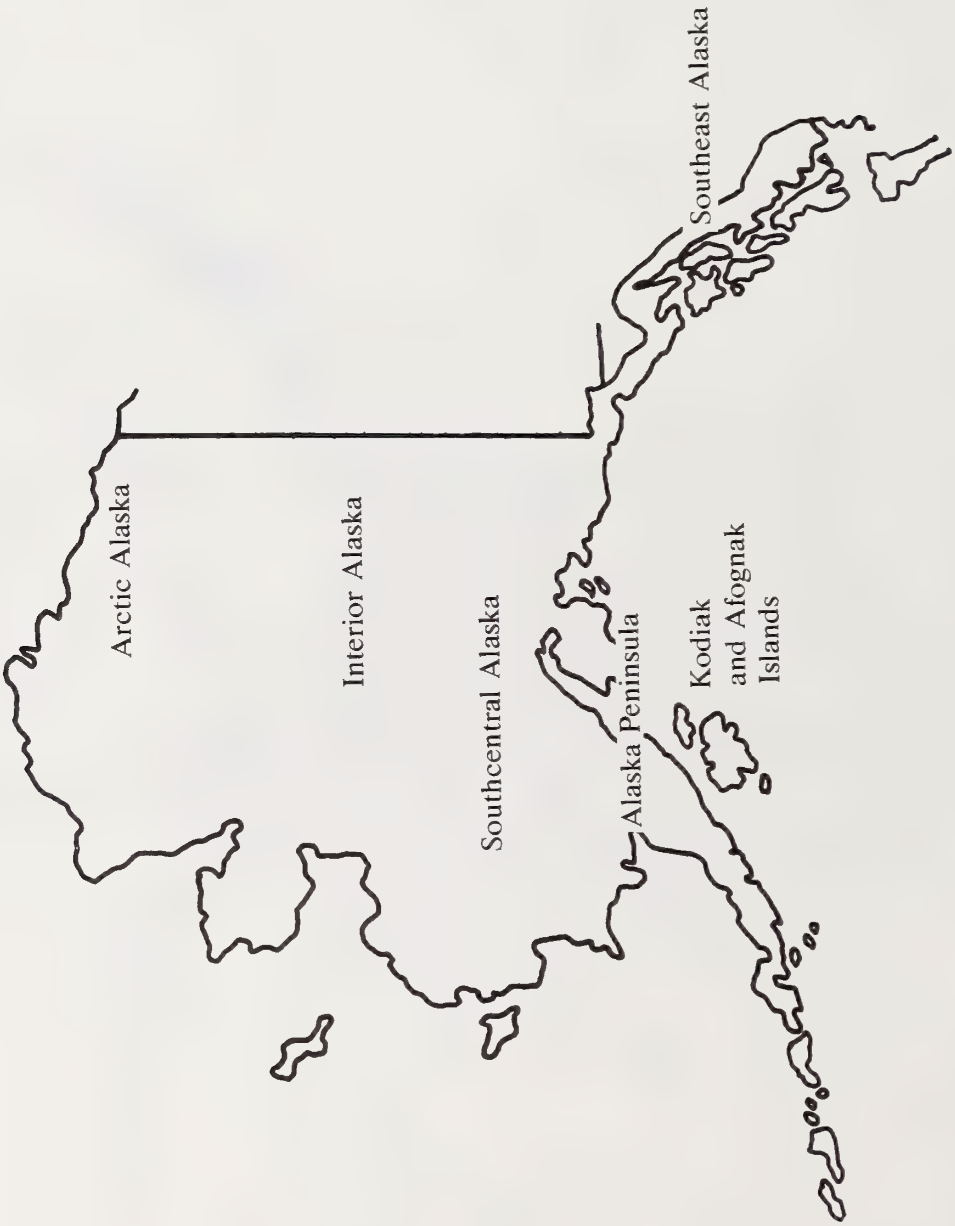


Figure 8. Grizzly Bear Management Areas in Alaska.



MORPHOLOGY AND PHYSIOLOGY

SIZE

A large number of reports reviewed included weight and measurement data along with capture records. Means and variance by age/sex class and season were usually not presented and this compilation of information does not attempt to analyze all of the new data from those reports lacking statistical compilations.

Weight data from most of the major capture studies are summarized in Table 1. Weights presented in the table are not directly comparable due to differences in season of capture and sample size; the original data must be reviewed for this information.

Other quantitative measurements (e.g., length, height, girth, skull size) were also available in the literature, but were inadequate for between-area comparisons. Nagy et al. (1984) discussed the relationship of weight to chest girth for 3 Canadian grizzly bear populations. Strong correlations between weight and girth have also been reported for grizzly bears in other areas (Russell et al. 1979, Glenn 1980, Blanchard in press). Bunnell and Tait (1981) noted that bears from coastal populations tended to weigh less than those from interior populations, evident trend in Table 1. The extremes were represented by the brown bears of the Alaskan Peninsula and the grizzlies of the southwestern Yukon. Males and females from the Peninsula were 2.8 times and 2.2 times heavier, respectively, than bears from the interior population. The actual difference may have been even greater since the Peninsula data were spring weights and the interior data were collected for all seasons.

Rausch (1963) compared the size of brown/grizzly bears from various North American populations based on condylobasal length of 357 skulls from 26 regions. He found that geographic variation was clinal with 1 well-defined gradient from coastal British Columbia to the end of the Alaskan Peninsula with mean condylobasal length increasing from south to northwest. This pattern was also evident from the limited weight data available. Mean weights of adult females were: southern British Columbia coast, 122 kg; southeast Alaska (Admiralty Island), 159 kg; Kodiak Island, 202 kg and Alaska Peninsula, 207 kg (Table 1).

Another gradient existed along the Arctic coast with skull size increasing from Coronation Gulf, N.W.T., west to the Noatak River region of northwestern Alaska. The trends for interior populations were less apparent; the smallest mean condylobasal length occurred in the southern Yukon with mean sizes increasing both toward the southeast and the northwest. Mean weights of male and female adult grizzlies from the southern Yukon (Pearson 1975) were also less than the mean weights from any other region (Table 1). In Alaska and possibly northwestern Canada, mean condylobasal lengths decreased from south to north and from west to east.

Rausch (1963) noted that the larger size attained by bears in coastal zones appeared to be correlated with the distribution of salmon and the "luxuriance" of coastal vegetation. He concluded that maximum size was genetically determined and was not affected by either the rate of growth or quality of the diet. Glenn (1980) observed that growth rates of captive brown bears suggested that adult size was generally fixed.

Blanchard (in press) reported that availability of garbage as a supplemental food source had a significant influence on grizzly bear weights in Yellowstone National Park. Both adult males and adult females with young that fed on garbage were significantly heavier than bears that did not. Mean weights of adult grizzlies in Yellowstone were heavier when open pit garbage dumps were available than after the dumps were closed. The mean annual weights of adult females which did not feed in dumps were highly correlated with annual habitat quality indices. Blanchard (in press) also examined weight data from 9 other North American bear populations. She found that, in general, females with reliable, high value foods (meats and berries) during summer and fall attained greater size, matured earlier and had larger litters than females with relatively low value foods (roots).

GROWTH RATES AND PATTERNS

Glenn (1980) in a short study of the morphometric characteristics of brown bears on the Alaskan Peninsula reported that both sexes experienced a period of rapid, continuous; growth in total body size (for several body and skull measurements) between the ages of 6 months and 2.5 years. Cranial dimensions showed a similar growth trend from 6 months to 3.5 years. There were no sex-related differences in body size at age 6 months, but yearling and 2-year-old males were larger than females for several morphometric measurements.

This period of rapid growth was followed by a period of more moderate growth during which males increased at a faster rate than females. From age 3 and older, males were significantly larger than females in all dimensions (including weight, body and skull measurements). Females attained at least 95% of their ultimate size (except in zygomatic width) by age 4-5, 2 years before that of males (ages 6-8). As indicated by cranial measurements, male rates of growth were approximately twice that of females between the ages of 6.5 and 15.5+ years. By age 9, there was no overlap between male and female bears in total skull size (sum of length and width).

Blanchard (in press) found that in Yellowstone National Park, male grizzlies were consistently heavier than females for all age classes except cubs and yearlings. Sexual dimorphism beginning at age 2 was also apparent in other study areas (Troyer and Hensel 1969, Pearson 1975). Males in Yellowstone steadily gained weight until at least 15 years, but the mean annual rate of weight increase for males aged 4-15 (5.6%) was much less than the rate for cubs through 3 years (42.1%). The mean weight of adult males was 29% greater than for females and body measurements were 8-17% greater. Males attained full size in 7 of 11 body measurements by age 6 and in all 11 by age 9.

The growth pattern for female bears in Yellowstone was less clear (Blanchard in press). Only 48% of the variation in female weight could be explained by age, compared to 62%

Table 1. Weight data (in pounds) recorded from grizzly bear capture records. Spring = emergence through June; Fall = August until den-up.

Ecosystem, Area and Citation	Adults (n) M	Adults (n) F	M:F	Max M	Max F	Yearlings (n) M	Yearlings (n) F	Cubs (n) M	Cubs (n) F	Comments
Yellowstone										
(Craighead and Mitchell 1982)	245 (33)	152 (72)	1.61	500	204	68 (39)	58 (19)	32 (34)	27 (17)	1959-1970 data; adult = 5+ years
(Blanchard in press)	192 (64)	135 (63)	1.42	325	194	63 (18)	58 (13)	24 (16)	22 (8)	1975-1985 data; adult = 5+ years (all seasons)
	222 (14)	142 (14)	1.56	325	194	—	—	—	—	dump feeders
	193 (49)	134 (48)	1.44			—	—	—	—	non-dump feeders
Northern Continental Divide										
North and South Fork Flathead Valley (Jonkel 1982)[a]	206 (7)	117 (3)	1.76	292	135	73 (1)	45 (2)	—	—	adult = 5+ years
Mission Mountains (Servheen 1981)[a]	218 (1)	163 (3)	1.34	218	218	—	54 (1)	59 (1)	46 (2)	adult = 5+ years fall weights
Rocky Mountain East Front (Aune 1985, Aune and Stivers 218 1982,1983, Aune et al. 1984)[a]	218 (1)	131 (2)		218	152	35 (1)	49 (4)	—	—	adult = 5+ years spring weights
Canadian Rockies										
Jasper National Park (Russell et al. 1979)	198 (13)	90 (3)	2.20	345	96	—	—	—	—	adult = 6+ years spring weights
	299 (4)	167 (4)	1.79	356	213	73 (1)	—	—	—	fall weights
	306 (3)	213 (1)	1.44	356	213	—	—	—	—	dump feeders (all seasons)
	203 (14)	121 (6)	1.68	311	159	—	—	—	—	non-dump feeders (all seasons)
Interior British Columbia										
Glacier National Park	257 (4)	128 (1)	1.85	354	131	32 (4)	—	—	—	Aug.-Sept. weights (Mundy and Flook 1973)
Boreal Forest										
Swan Hills, Alberta (Nagy and Russell 1978)	218 (2)	178 (3)	1.22	218	206	57 (3)	41 (3)	—	23 (1)	adult = 6+ years (all seasons)
Northern Interior										
Southwest Yukon (Pearson 1975)	139 (40)	95 (21)	1.46	240	125	40 (6)	28 (1)	12 (1)	—	adult = "mature" (all seasons)
Mackenzie Mountains, NWT (Miller, Barichello and Tait 1982)	148 (20)	110 (28)	1.34	214	147	63 (3)	—	30 (2)	—	adult = 5+ years (all seasons)
Canadian Arctic										
Northern Yukon (Nagy et. al. 1983a)	178 (37)	116 (40)	1.53	272	186	—	—	—	—	adult males = 8+ years; adult females = 6+ yrs. (all seasons)

Table 1. (Continued)

Ecosystem, Area and Citation	Adults (n) M	Adults (n) F	M:F	Max M	Max F	Yearlings (n) M	Yearlings (n) F	Cubs (n) M	Cubs (n) F	Comments
Northwest Territory (Nagy et. al. 1983b)	189 (18)	122 (46)	1.55	283	230	43 (12)	36 (7)	10 (2)	10 (4)	adult males = 7+ years; adult females = 5+ yrs. (all seasons)
Arctic Alaska										
Western Brooks Range (Reynolds and Hechtel 1982)	145 (24)	104 (24)	1.39	218	134	34 (1)	24 (3)	12 (3)	9 (4)	adult = 5+ years May - June weights
	210 (4)	130 (9)	1.61	236	181	—	—	—	18 (3)	Aug-Oct weights
Eastern Brooks Range (Reynolds 1976)	205 (9)	116 (14)	1.77	272	141	50 (2)	43 (2)	—	—	(Aug-Oct weights) 1974
North Slope (Crook 1972)	254 (3)	155 (5)	1.64	313	209	—	—	—	—	adult = 5+ years (summer/fall wts)
Arctic Natl. Wildlife Refuge (Garner et. al. 1984)	135 (22)	93 (32)	1.45	184	116	20 (4)	—	9 (2)	6 (2)	May - July weights
Interior Alaska										
Alaska Range (Reynolds and Hechtel 1983a)	176 (5)	114 (12)	1.54	172	141	48 (2)	40 (2)	12 (2)	12 (3)	adult = 5+ years (May 15 - July 15)
Southcentral Alaska										
Nelchina Basin (Miller and Ballard 1980)	243 (18)	119 (21)	2.04	289	170	40 (8)	38 (6)	5 (3)	5 (1)	adult = 5+ years (spring weights) 1978-1979
Nelchina Basin (S.D. Miller 1984)	221 (16)	128 (28)	1.72	317	204	30 (3)	4 (1)	5.4 (5)	4.7 (3)	adult = 5+ years (spring weights 1980-1983)
Alaskan Peninsula										
Peninsula (Glenn et al. 1976, Glenn 1971,1973a,1980)	389	207	1.88	442	275	82	51	—	—	adult = 9+ years (spring weights)
Kodiak/Afognak										
Kodiak Island (Troyer and Hensel 1969)	312 (10)	202 (16)	1.55	411 (fall)	299	67 (20)	63 (22)	23 (17)	22 (15)	adult = 6+ years (midsummer weight unless indicated)
Southeast Alaska										
Admiralty Island (Woody 1976)	—	159	—	—	227	84	—	31	36	adult = 9+ years (Sept 1972 and 1973)

[a]Weights estimated from body measurements

for male bears. The mean annual rate of increase for females aged 4-13 (5.2%) was much less than the rate for cubs through 3 years (36%). An observed decrease in weight at age 6 may have been related to the nutritional costs of first cub production. Females reached mean adult size in 5 of 11 body measurements by age 4 and in the remaining 6 by age 7.

Troyer and Hensel (1969) reported that growth rates of male and female bears began to diverge at age 4. Limited data indicated that females approached their maximum size by their sixth summer while males continued to grow at a near constant rate until approximately age 9. Cessation of growth in females appeared to correspond with attainment of sexual maturity.

Kingsley et al. (1983) studied the growth patterns of 2 populations of grizzly bears in northern Canada. They found that the ultimate spring weight for males was nearly twice that for females, but males took 14 years to reach 95% of this weight while females took only 9 years. In another study, Kingsley et al. (in press) used "zoological length" (length along the spine from nose to tip of the tail) to study grizzly bear growth patterns. Their analysis showed that, unlike the weight-age patterns discussed above, the length-age curves for the 2 sexes differed very little. The male asymptote was 21 cm larger than the female but both curves leveled off quickly. Females reached 90% of the asymptotic length at only 4.02 years and males reached this length at 4.69 years. Thus, for male bears, skeletal growth appeared to be completed rapidly while weight tended to increase throughout the normal life span. These results contrasted with Glenn's (1980) finding that males showed protracted growth in both length and weight (age for 95% total length was 4 years and 6 years for females and males, respectively).

The growth patterns of a grizzly bear population in the western Brooks Range, Alaska, differed significantly from the patterns observed for the 2 northern Canadian populations (northern Yukon and Tuktoyaktuk Peninsula). The initial growth rate (based on zoological length) for the Alaskan population was about 75% of the Canadian rate; Alaskan grizzlies reached 90% of their asymptotic length 1.4-1.9 years after the Canadian bears; however, Alaskan bears were 5 cm longer than the Canadian bears. In both regions, the age of first reproduction (6 years for northern Canada and 8 years for northwestern Alaska) corresponded to the age when females attained 95% of their asymptotic length. Kingsley et al. (in press) suggested that, as indicated by mean home range size, the Alaskan population might have been on a lower nutritional plane.

Kingsley et al. (in press) also studied the ecological aspects of sexual dimorphism in bears. They felt that competition for range and mates resulted in a selective advantage to large size for adult males. The selective advantage to females should be to complete growth early in life and, after attaining some minimum size, divert energy from growth to reproduction.

Bunnell and Tait (1981) noted that sexual dimorphism does not generally serve to partition food resources in large omnivores. They suggested that the larger body size of male bears favored the establishment of larger home ranges and, thus, access to a greater number of potential mates. Large size also conferred a selective advantage in intraspecific conflicts during the breeding season. The smaller body size of females enables them to establish smaller, more exclusive home ranges — a benefit while rearing young.

Seasonal Patterns of Weight Gain and Loss

Kingsley et al. (1983) studied seasonal weight changes in two northern Canadian grizzly bear populations. The fall asymptotic (final) weight for males was 28% greater than the spring asymptotic weight. During the first summer, male weight tripled and, thereafter, the relative weight gain (percent increase over spring weight) declined each year. The relative weight loss in winter remained fairly constant (slightly greater than a 20% decrease of the fall weight) throughout the lifespan. In contrast, female bears cycled more weight than males, both absolutely and relatively. The greater relative weight fluctuation in females was apparent from the age of first reproduction on. The gain and loss increased with age until the oldest females were cycling 70% of their spring weight.

In the Yellowstone ecosystem, adult grizzly bears lost weight from the time of den emergence through July and generally regained their emergence weight by August (Blanchard in press). Limited data suggested that subadults did not regain their emergence weight until September. Two-year-old grizzlies showed the lowest spring to fall weight gain, probably as a consequence of stress from weaning and dispersal; weaned yearlings steadily lost weight from July to September. Females showed the greatest spring to fall weight gain as 3- and 4-year-olds (30 and 29%, respectively), while males showed the greatest gain as 4- and 5-year-olds (39 and 34%, respectively). The greatest daily weight gain was for 2 3-year-old males which gained 1.3 kg/day over 17 and 22 days, respectively. Adult bears exhibited increases of 6-10% and 15% for females and males, respectively. Over winter, adult males lost a greater percent of body weight than adult females (18% as compared to 8%). These findings contrast with those of Kingsley et al. (1983) discussed above in that they reported that adult females lost higher percentages of their fall weight in the den.

Craighead and Mitchell (1982) discussed the seasonal patterns of weight gain and loss for Yellowstone grizzlies during the 1959-1970 period. Observation of feeding behavior and weight records suggested that losses in body weight during April and May exceeded gains. By June, grizzlies were on a normal feeding regime but still exhibited little or no gain in body weight until late July or August; however, from mid-July through September, weight gains were substantial. Observed weight gains for individual bears were 1.65 kg/day for a 2-year old female from mid-July to mid-August, 0.97 kg/day for a yearling male over a similar period and 1.13 kg/day for an adult female over a 26-day period. Observed weight gains for longer periods of time were 0.41, 0.24 and 0.46 kg/day over 111, 114 and 118 days, respectively.

Troyer and Hensel (1969) inferred from the available data that brown bears on Kodiak Island lost about 30% of their acquired fall weight while denning. Male bears continued to lose weight rapidly after emergence; however, spring weight losses for mature females and immature bears were less pronounced as they remained in the den longer. The weight lost in spring was usually regained by

midsummer. Summer-to-fall weight gains ranged from 110% for cubs to 42% for 5-year-olds. One 3-year-old male gained 20 kg per day and another 3-year-old male gained 1.05 kg/day. Troyer and Hensel (1969) also provided an excellent discussion of fat deposition patterns based on inspection of carcasses.

Nagy et al. (1983b) reported that in the Northwest Territories, 3 adult males gained an average of 0.29 kg/day from spring to late summer or fall (mean of 111 days). Three subadult males had average daily increases of 0.35 kg/day over a mean of 102 days. Maximum rates of gain were 0.49 kg/day for an adult male over 117 days and 0.51 kg/day over 81 days for a subadult male. Average weight gains for 4 adult and 2 subadult females were 0.42 and 0.38 kg/day, respectively, from mid-August to mid-September while feeding mostly on ground squirrels. The results suggested that rates of gain were dependent on season, availability of various food items, feeding habits of individual bears and the reproductive status of females.

Weight losses during winter were highly variable for grizzly bears in the northern Northwest Territories (Nagy et al. 1983b). Total weight losses during the denning period averaged 0.19 kg/day over 255 days for 2 adult males (24% weight loss), 0.02 kg/day over 256 days for 1 subadult male (5% loss), 0.18 kg/day over 249 days for 5 adult females (30% loss) and 0.10 kg/day over 249 days for 2 subadult females (34% loss).

Nagy et. al. (1983a) reported that in the northern Yukon, the average weight gain for 3 adult males was 0.57 kg/day over 116 days from May to September (50% weight gain). The greatest weight gain for an adult male was 0.74 kg/day over 112 days. Two adult females with yearlings gained 0.14 and 0.58 kg/day over 28 and 62 days, respectively. Over-winter weight losses averaged 0.22 kg/day for 5 adult males and 4 adult females over 238 days. This loss corresponded to average reductions in body weight of 25% and 36% of males and females, respectively.

Pearson (1975) reported that in the southern Yukon the average over-winter weight loss for 4 grizzly bears (2 adult males and 2 subadult females) was 0.2 kg/day for an average of 220 days. These animals lost 28-43% of their fall weight in the den.

Weight increases in the fall were rapid. An adult male gained 0.41 kg/day for 126 days and an immature female gained 0.64 kg/day for 16 days in August. Nagy and Russell (1978) reported gains of 330% over 148 days (0.39 kg/day) for a 2-year-old male and 91% over 90 days (0.36 kg/day) for an immature female in the Swan Hills region of Alberta. Russell et al. (1979) reported that 2 subadult grizzlies in Jasper National Park gained an average of 0.22 kg/day from spring to autumn. The average rate of loss for 3 grizzly bears from denning to emergence was 0.22 g/day.

Several studies presented data on weight gains of captive grizzlies or brown bears. Bunnell and Tait (1983) fed 2 captive yearlings various experimental diets including horse meat, dog food, blueberries, salmon and beet pulp. During a 190-day trial period, the male yearling gained 0.63 kg/day (133% increase) and the female gained 0.51 kg/day (129% increase). Captive male and female brown bear cubs at the Houston Zoo gained 6.0 and 4.4 kg/month, respectively, from birth to 4 months. A female brown bear cub reared at the Copenhagen zoo gained 7.1 kg/month during its first 7 months (Ben Shaul 1962). Jonkel et al. (1980) reported that a captive grizzly cub, fed a diet to encourage maximum weight gain, increased its weight by 12.7 kg in 31 days (0.41 kg/day).

PELAGE AND MOLT

Great variation in color and color patterns exists throughout the range of the grizzly bear and is discussed briefly, by ecosystem, below.

Yellowstone Grizzly Bear Ecosystem

Knight et al. (1981) reported great variation in the pelage characteristics of Yellowstone grizzly bears. The distribution of lighter tipped guard hairs resulted in various patterns affected by light conditions. They found 5 major color patterns in the following frequencies: girth band (n=28, 44%); medium (n=14, 22%); gold/silver (n=9, 14%); multicolored (n=8, 12%) and black (n=5, 8%).

The most common color pattern found in the Yellowstone ecosystem was "medium to dark brown underfur; brown legs, hump and underparts; light to medium grizzling on the head and part of the back and a light colored girth band or patch behind the forelegs" (Knight et al. 1981). Other common color patterns included overall gold or silver appearance with brown underparts and occasionally a dark back stripe; bears lacking silver-tipped guard hairs and appearing black or brown; and bears appearing mostly dark brown with grizzled forequarters and face. Subadults were often multicolored with a light-colored yoke. These distinctive color patterns often faded with maturity.

Montana (statewide)

Greer and Craig (1971) reported that the pelage of individual grizzlies varied annually. About 50% of the pelts examined by taxidermists were grizzled, 30% were dark and 20% were lighter than the usual base black. Young animals were often lighter than adults.

Northern Continental Divide Ecosystem

Peacock (1978) found that in Glacier National Park the high degree of variation by season and illumination condition precluded the use of color marking and size for individual recognition. He discussed 3 cases in which striking color patterns faded markedly over time.

Canada

Boreal Forest

Nagy and Russell (1980) reported that most northern Alberta bears were brown. Others had brown underfur with blonde to white guard hairs over the head, shoulder and back with darker legs.

Canadian Rockies

Russell et al. (1978) found that about half of the grizzly bears in Jasper National Park were brown, some with a yellowish tinge on the sides and back. The rest had prominent blonde, yellow or silver-tipped guard hairs on the

sides, back and neck. Heads were brown to yellow, the humps were darker than the torso and the legs were still darker.

Yukon

Pearson (1975) found that 72% of the grizzly bears he examined were brown (most commonly chocolate-brown underfur with silver-yellow guard hairs over neck and shoulders). The rest were blonde or yellow usually with a dark dorsal stripe and dark brown legs. Bears which were blonde or light yellow all over were least common. Pearson attributed very light coloration to bleaching which was, at least in part genetically regulated.

Chronology of the molt varied by age and sex class with mature males molting first (beginning in early July) followed by younger males and mature females (beginning in mid-July). The molt was completed by late July or August. In an earlier report, Pearson (1965a) noted that grizzlies appeared to lighten in August and gradually darken until October when most were again brown.

Similarly, Nagy et al. (1983a) found that in the northern Yukon, grizzly bears ranged from basic "chocolate" or lightly grizzled brown to blond animals with dark leggings. The affects of bleaching were described for 24 animals which were handled more than once during the study. Ten bears changed color patterns between handling including 60% of the males and 11% of the females. Pre-molt bears captured in the spring gradually faded or bleached to a straw blond color. After the molt these bears appeared as sleek brown once again.

Northwest Territories

As observed in the Yukon, grizzlies in the far northern, Northwest Territories ranged from a basic chocolate, light grizzled or rufous brown to blond with dark brown or black leggings. The affects of bleaching were described for 38 bears. Thirty-seven percent of these changed color, including 52% of the females and 13% of the males. (This sex-specific trend was opposite to that observed in the Yukon by Nagy et al. 1983a.)

Alaska

Rausch (1953) reported that for the Brooks Range, the general pattern was a light colored head and shoulders; dark back, sides and belly and still darker legs and feet. Overall, coloration varied from pale-yellow to black. He noted that bears in the Alaskan Peninsula and Kodiak-Afognak area may be more uniformly colored but exceptions were common. Erikson (1965) presented pelage data from 995 brown/grizzly bear pelts from 5 different harvest areas in Alaska. As in Rausch (1953), he found that coastal bears were more uniformly colored than interior bears, the latter being more mottled and often having light-tipped guard hairs over a dark underfur. Fewer bears were light blonde and creamy-white. The legs of all forms were dark. Most cubs had a white "collar" throughout their first summer and failed to shed during that period. Thirty-three percent of the spring kills had "rubbed" hides indicating shedding while only 5% of the fall hides were rubbed.

Quimby and Snarski (1974) reported that grizzly bears in Arctic Alaska were generally lighter than bears in other parts of the state. More than 50% of the adults observed by Crook (1971) in 1970-1971, were light brown or blond. Quimby and Snarski (1974) found that dark colored bears predominated in the population during May, September and October, while lighter-colored bears predominated during June — August. They attributed these trends to differences in timing of emergence, sex-specific differences (darker colored males emerged before the lighter colored females), bleaching and general observability by sex.

Troyer and Hensel (1969) described the pelage characteristics of Kodiak Island brown bears. Cubs, hairless at birth, could have hair up to 4 in length by fall. Young bears frequently had white "collars" which faded by the time the bears emerged as 2-year olds. Cubs and immatures were otherwise more uniformly colored and had less inter-bear variation than adults. Adult males tended to be darker, have shorter, less dense, hair than females (except along their dorsal midline). Shedding occurred through the mid-season and may have begun before den emergence. Twenty-nine percent of the spring hides examined were "rubbed" (in post-shedding condition) as opposed to only 8% of the fall hides.

General

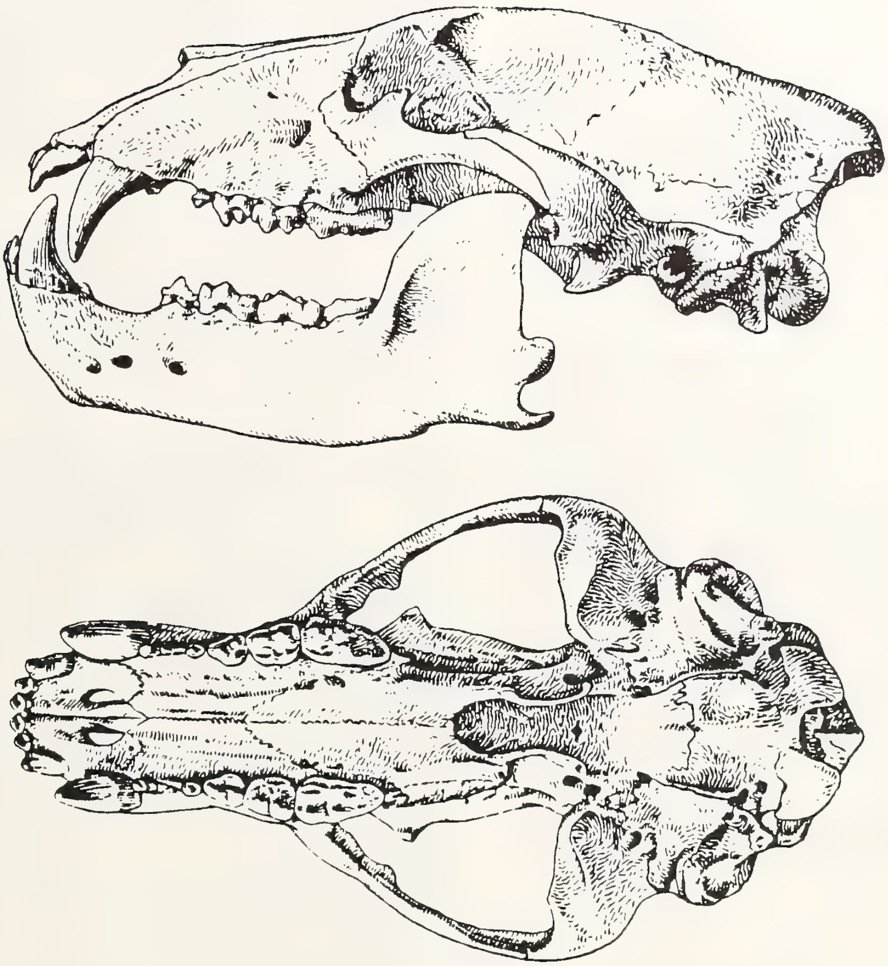
Moen and Rodgers (1985) measured the radiant temperatures on 4 main body zones of the black bear and discussed the variation due to hair depth, exposure (body position) and other factors. Although he did not discuss bears specifically, Walsberg (1983) studied the thermal aspects of coat color and concluded that there was not a simple relation between pelage and solar heat gain as is commonly presumed. Rogers (1976, 1980) discussed the genetic basis for pelage color in black bears. He found that certain reproductive parameters were associated with coat color. Lighter colored females produced significantly larger litters than darker sows, but the cubs of the former group weighed less and experienced higher mortality in poor food years. He also speculated that mimicry of grizzly bears may provide, along with thermal regulation and camouflage, one basis for light coloration in black bears. The converse may be true, although it has not been studied.

SKULL AND DENTITION

Skull

Skull size, relative proportions and details of dentition are important in determining age, sex and subspeciation in grizzly bears (Fig. 9) (Merriam 1918, Rausch 1953, Mundy and Fuller 1964, Zavatsky 1976). The skull of Ursus arctos grows and changes in structure over the entire life of the animal. Bear cubs possess a circular shaped skull which lengthens during growth and at the time of sexual maturity (3-4 yrs. in females; 4-5 yrs. in males), the skull has the characteristic form for the species (Zavatsky 1976). Condylobasal length and zygogamatic width are frequently measured skull charcteristics; however, the latter dimension continues to increase after maximum skull length has been attained (Rausch 1963). Zavatsky (1976) recognized 11 distinct age classes using external characteristics of the skull, teeth and live weight of the bear. He claims that "with this method, accuracy of age determination to the 4th year is within 1-2 months and from the 4th to the 18th year is to within 2-3 years."

Figure 9. Skull of the Brown Bear.



The largest grizzlies of most age categories are usually males, although some females may exceed small males in size. Glenn (1980) found that sex-related size differences were not apparent until about 6 months of age. Yearling males, however, were significantly larger than yearling females. Males at age 2 were larger in skull length and body weight, while at age 3 years and greater, all dimensions of males were significantly greater than those of females. In the same study, 95% of the female's ultimate dimensions (e.g., shoulder height, body length, skull length) were attained by 4 years, weight and skull size by 6 years and zygomatic width by 8 years. Similar ultimate size dimensions were not attained in males until ages 6, 8 and 10 years, respectively.

It is important to realize how variable skull dimensions can be within the species. Rausch (1953:102) emphasized this by stating:

> "There is apparently so much individual variation in bear skulls that generalizations regarding the animals of a given locality can rarely be made. A great range in skull size is to be expected. There may be considerable variation in the length/width ratio of the skull (condylobasal length/zygomatic width) from a single locality. Skull profile is subject to much variation: in some cases the frontal region is gradually sloping and concave, while in others it is inflated and slopes abruptly. Rostral length is variable, and the nasals may show considerable range in length. The sagital crest may show much variation in degree of development, height and anterior-posterior extent. Variation is to be expected in the length and width of the palate. The ramus of the mandible varies greatly in form and relative length. The angle formed by the long axis of the skull with the horizontal, when the skull is at rest on the flat surface, differs from one individual to the other largely on the basis of mandible shape."

Variability within the species led Merriam (1918) to distinguish approximately 90 species of North American bears. He "failed to take into consideration any possibility of individual variation. Some 'species' were named on the basis of a single skull, and in some cases not even the sex of the animal was known" (Rausch 1953:86). Hall (1984) measured 2476 adult, subadult and juvenile grizzly skulls and from this information concluded that 9 subspecies existed in recent time.

Dentition

Bears have the general dental formula: I3/3, C1/1, P4/4, M2/3 for a total of 42 teeth. However, bears often have some, or all, of their first 3 upper and lower premolars missing (Glass 1973). The formidable dentition of *Ursus* is a valuable tool when aging an individual animal. The length of the teeth and their relative position in the skull are indicators of the approximate age of the animal. The permanent teeth of bears are useful for tracing age-related changes because they are large and develop relatively slowly (Rausch 1969). For a more detailed description of the development of the dentition in *Ursus arctos*, the reader is referred to Rausch (1969) "Morphogenisis and Age Related Structure of Permanent Canine Teeth in the Brown Bear in Arctic Alaska." Zavatsky (1976), uses dental development as an indicator of age in his designation of the 11 age classes of the grizzly.

The chronological age of many mammals can be accurately determined from the annual layers of dentin or cementum. Layers of cementum are produced when odontogenesis (tooth development) is interrupted during the annual period of denning. The age in years is determined by adding 1 to the number of annuli counted in the cementum of the third molar. Mundy and Fuller (1964) found that the number of annuli present is also correlated with the magnitude of the zygomatic width. It is important to note that bears that do not hibernate (i.e., captive bears) do not show the charcteristic annual deposition of dentin (Rausch 1967).

Molar measurements are also useful as a taxonomic tool in *Ursus* (Gordon 1977). Skulls of *U. arctos L.* and of *U. americanus* are quite similar; the inability to separate the 2 species is particularly acute when comparing female skulls of *U. arctos* with male skulls of *U. americanus*. Gordon (1977) acheived 100% accuracy in the separation of these 2 species in a sample of 128 previously identified specimens using length and width measurements of the first mandibular molar.

Much can be learned from examining skulls, particularly when it comes to aging the animal. However, clinal and geographic differences in cranial and dental dimensions within the species must be recognized (Table 2). The reader is referred to Rausch (1963) for a more detailed discussion.

Table 2. Summary of numerical data on 26 skull samples from various regions of North America (from Rausch 1963).

Region	N	Mean	Range
Lower Alaska Peninsula	25	404	372-429
Port Heiden — Becharof Lake	10	402	379-432
Kamishak Bay — Iliamna Lake	26	377	351-405
Kodiak — Afognak Islands	37	397	372-433
Kenai Peninsula	18	385	368-409
Skwentna Region	10	366	353-382
Mt. McKinley Region	7	349	320-374
Talkeetna Mountains Region	16	366	343-394
Nabesna Region	7	343	326-353
Lower Copper River	5	386	374-400
Yakutat Bay Region	11	376	367-391
Chichagof Island	19	370	345-385
Admirality Island	33	361	330-385
Baranof Island	14	363	342-400
Bella Coola Region	12	361	342-386
Norton Sound	9	353	321-374
Upper Noatak River	4	352	341-363
Anaktuvuk Pass Region	11	334	307-357
Mackenzie Delta	9	335	320-346
Coronation Gulf	8	324	306-344
Western Yukon Region	11	330	299-358
Southern Yukon Region	12	330	318-344
Southeastern Yukon Region	8	334	303-361
Cassiar Mountains Region	15	346	311-371
Southeastern British Columbia	10	337	318-356
Montana-Wyoming	10	347	323-368

HEMATOLOGY

Most of the literature on bear hematology primarily concerns black bears. Only papers which specifically discussed grizzlies are included below.

1. Seal et al. (1967) analyzed serum from 7 captive brown/grizzly bears for major blood parameters. Interspecific differences within the Ursidae were discussed.
2. Craighead et al. (1962) presented hematological data for 3 grizzlies. Craighead and Craighead (1970) found low circulating thyroid levels in Yellowstone grizzlies suggesting a hypothyroid state.
3. Jonkel and Greer (1975) discussed methods for collecting and analyzing blood data.
4. Halloran and Pearson (1972) and Pearson and Halloran (1972) reported statistically significant seasonal changes in the major blood parameters of 22 brown bears from southwestern Yukon Territory. Minor sex-related differences were also noted.
5. Miller and Ballard (1980) reported on blood data from 45 brown bear samples collected in southcentral Alaska. Their data included age and sex of the bear, serum levels of glucose, electrolytes, major proteins and other compounds of interest. They also presented protein electrophoresis data from their samples. Sparker and Ballard (1979) and Sparker et al. (1981) analyzed blood data for 31 bears from the same area (some overlapping data with Miller and Ballard 1980).
6. Franzmann et al. (1981) measured beta-endorphin levels from the blood of 3 Alaskan brown bears. Based on black bear data, they speculated that beta-endorphin may play a role in winter lethargy.
7. Brannon (1983ab, 1985) analyzed hematological data from 85 grizzly bears captured in the Alaska Range and in the Arctic National Wildlife Refuge. Samples were examined for erythrocyte count and leukocyte count, as well as hemoglobin, hematocrit and erythrocyte indices. He related the differences in some parameters to physiological response to capture stress. Regional variation in blood parameters may also have been stress-related. Differences in urea nitrogen, ureatinine and uric acid varied by capture date suggesting regained renal function and dietary adjustments after den emergence. The effects of Serynlan on blood parameters were also discussed.
8. Nelson et al. (1983a) reviewed the annual behavioral and biochemical patterns of grizzlies and other ursids. Variation in blood parameters according to physiological stage was discussed for black and polar bears. Elsewhere (Nelson 1973, 1978, 1980, 1984; Nelson et al. 1973, 1975, 1984), the relationships between hibernation physiology, protein metabolism and associated blood parameters were discussed. Changes in serum urea and serum creatinine before and during hibernation was analyzed.

BODY TEMPERATURE, RESPIRATION, AND HEART RATE

In general, grizzly bears exhibit the basic systemic physiology common to most mammals (Craighead 1982). The major notable exception to this is the period of hibernation, or winter sleep, during which the bear may not eat, drink, defecate, or urinate for a period of 3-5 months. Respiration, heart rate and core temperature are significantly reduced during this period.

During the normal active season, internal body temperatures of grizzly bears range from about 36.5-38.5 C and are reduced by 4-5 C during the period of winter sleep, (Irving 1954, Hock 1958, Folk 1967, Folk et al. 1968b, Nelson 1973, Folk 1976, Follman 1978). As bears enter into winter sleep their heart rate decreases from summer sleeping rates of 40-50 beats/min to a low of 8-12 beats/min (Folk et al. 1978). This bradycardia and reduction in oxygen consumption by as much as 50% is apparently associated with the shunting of most of the blood to the heart, lungs and brain (Folk et al. 1976). Temperature and heart rate sensitive radio transmitters surgically implanted in bears have been important in giving insight into these physiological changes (Folk 1964, Craighead 1971, Philo et al. 1981, Follman et al. 1982).

A variety of drugs have been used to immobilize grizzly bears for research or relocation with varying effects on respiration, heart rate, and body temperature (Table 3). The drug is usually administered by a projectile syringe. Therefore, only those narcotics with a small effective dosage level are acceptable due to the limited capacity of the darts. It is important to be aware of dosage levels, side effects, antidotes, administration technique, toxicity to humans and legal status of a particular drug before beginning field studies.

SENSORY SYSTEMS

Knowledge of sensory systems is very limited. However, combined with research conducted on similar species within the family Ursidae, it provides basic information on grizzly bear audition, vision and olfaction.

Kuchak (1937, in Pruitt and Burghardt 1977) found the auditory system of brown bears to be well developed, observing responses to signals at distances of 150 m.

Regarding vision, Kuchak (1937, in Pruitt and Burghardt 1977) estimated that recognition occurred at distances up to 15 m. However, Craighead and Craighead (1964) expanded this figure to 60 m based on behavioral observations. In addition, Bacon and Burghardt (in press, in Pruitt and Burghardt 1977) demonstrated the ability of black bears to discriminate hues and patterns.

As their most developed sense, smell was determined to be the major factor in locating hidden food items (Kuchuk 1937, in Pruitt and Burghardt 1977). However, foraging, feeding and predatory behaviors are thought to be facilitated by an integration of all three systems (Pruitt and Burghardt 1977).

Table 3. Affects of various drugs on grizzly/black bear heartrate and respiration.

Species	Drug	n	x Dosage	x Temp (t)	x Heartrate Beats/min	Respiration/min	Time to Take Affect	x Duration/min	Comments	Citation
Grizzly	Succinylcholine chloride	20	.18 mg/lb	—	—	—	4.0	9.4	can cause respiratory failure	Pearson 1968
Black		20	.19 mg/lb	—	—	—	3.3	9.4		Pearson 1968
Grizzly	Phencyclidine hydrochloride	22	.68 mg/lb	—	—	—	10.6	140		
Black		11	.63 mg/lb	—	—	—	15.2	179		
Grizzly	Sernylan + Sparine 1:1	18	.76 mg/lb	—	—	—	14.0	—	2 bears convulsed but recovered	Skonjsbergt and Westhover 1979
Polar	Tiletamine hydrochloride + Zolazepam hydrochloride 1:1	11	4.9 mg/kg	36	89.0	12.9	4.91	125.5	darted at dump or in cage	Haigh 1985
Polar		13	5.3 mg/kg	37.1	103.8	16.2	6.9	126.5	darted from helicopter, ran for up to 20 min.	Haigh 1985
Black	Alpha-chloralose	8	2.5 gm	—	53.8	9.8	47.5	714.0	1 caged bear, 8 trials with drug placed in food. Field test, culvert trapped males, drug placed in food.	LeCount 1983
Black		7	2.9 gm	—	77.5	11.3	63.1	805.7		LeCount 1983
Grizzly	Etorphine hydrochloride (m99)	27	.06 mg/kg	—	46.0	2.0	5.6	38.9	severely depresses respiration, can cause hypothermia, toxic to humans	Hebert 1980
Grizzly	Etorphine + Xylazine	6	1.4 mg	—	—	2.5	7	—	Diprenorphine given as reversal agent	Gatesman 1982

DIGESTIVE SYSTEM

Davis (1964) reported that in carnivores the ratio of intestine to head and body length was broadly correlated with diet. Those families such as Canidae, which exclusively ate meat, tended to have smaller intestine to body length ratios than more omnivorous families such as Ursidae. However, in no carnivore was this ratio as great as in mammalian groups which were primarily, rather than secondarily, herbivorous (e.g., the artiodactyls, with ratios up to 25:1). Davis (1964) reported ratios of 4.5:1 for the wolf, 5-6:1 for the domestic dog and 7.9:1 for the brown bear. The total intestinal length for the brown bear was 10.7 m. Mealey (1975) gave ratios of 7.4 and 4.3 for 2 grizzly bears from Yellowstone, with total intestinal lengths of 9.8 and 8.6 m, respectively.

Bielanska — Osuchowska and Szankowska (1970) reported an average intestinal length in adult brown bears of 7-10 m, but accurate measurements were made on only 2 bears (8 and 10 m). This study also detailed histological examinations of the alimentary tracts of 18 brown bears. The researchers found that the general histological structure of the esophagus, stomach and intestines was not, in principle, different from other carnivorous mammals (chiefly dogs and cats).

Jaczewski et al. (1960) studied the capacity of the different parts of the digestive tract in the brown bear. The absolute length of intestines from 3 male bears were 9.3, 11.2 and 17.4 m, with ratios of intestine length to body length of 5.1:1, 6.1:1 and 7.7:1 respectively. Other characteristics of the digestive system also indicated adaptations principally to a meat diet. The capacity of the stomach was nearly 50% of the total digestive tract capacity. The strong, well-developed muscular coat of the digestive tract and the lack of difference between the large and small intestine were also typical of carnivorous species.

A general preponderance of the foregut and a reduction of the caecum and hindgut exists in Carnivora (Ewer 1973). Since, unlike ungulates, bacterial fermentation is of minor importance to the digestive physiology of carnivores, the size of the caecum in the different families does not a strong relationship to the importance of vegetation in the diet. Mealey (1975) found no caecum in 2 grizzly bear carcasses he examined. Ewer (1973) reported that the caecum was absent in bears. This suggested that the considerable reliance on vegetable foods by most members of Ursidae (along with Mustelidae and Procyonidae) was a secondary habit arising after the caecum was already lost in ancestral forms. Jaczewski et al. (1960) found a small caecum (about 5 x 1 cm) in 1 older brown bear.

Bunnell and Hamilton (1983) studied the apparent digestibilities of dry matter, crude protein and gross energy for 2 captive grizzly bears. They reported that the grizzly's ability to digest dry matter and crude protein was similar to that recorded for obligate carnivores. The digestive system was essentially that of a carnivore with herbivorous adaptations of modified dentition and lengthened claws. These adaptations do not enable the grizzly bear to digest coarse forage efficiently. An increase in dietary fiber dramatically decreased the apparent digestibilities of fiber, dry matter, gross energy and, to a moderate extent, crude protein.

GENETIC CONSIDERATIONS

The loss of genetic variation associated with small population size is an important concern in conservation biology. A detailed discussion of the genetic principles involved is beyond the scope of this narrative. Several recent books have treated this topic extensively (e.g., Soule and Wilcox 1980, Frankel and Soule 1981, Schonewals-Cox et al. 1983). Shaffer (1986) reviewed these works and summarized the basic conclusions regarding genetic aspects of population viability.

Small populations can experience reduced genetic variation in 3 ways (Frankel and Soule 1981, Schonewald-Cox et al. 1983, Shaffer 1986):

1. The Founder effect — populations founded by only a few individuals have limited genetic "raw material."
2. Genetic drift — loss of genetic variation due to random sampling of gametes each generation; more pronounced in small populations due to low representation of rare alleles.
3. Inbreeding — continued mating of closely related individuals.

A genetic bottleneck occurs when a population is reduced to a few individuals as a result of a major environmental change, a natural colonization or an artificial founder effect. Populations passing through a bottleneck reflect both qualitative and quantitative losses of genetic variability. Qualitatively, certain alleles are lost or retained and quantitatively, the amount of variability for specific characteristics can be reduced. At low numbers, a population essentially goes through a serious bottleneck each generation with the deleterious effects being cumulative (Frankel and Soule 1981).

The deleterious effects of reduced genetic variation have long been recognized from studies of domestic animals (Allendorf and Leary in press). In natural animal populations, the loss of heterozygosity due to inbreeding depression has been associated with decreases in survival, disease resistance, growth rate and developmental stability. The antithesis of inbreeding depression is heterosis — the enhancement of fitness (e.g., viability, vigour, fecundity, fertility) due to increased heterozygosity (Frankel and Soule 1981). The genetic mechanisms underlying inbreeding depression and heterosis have not been fully revealed (Allendorf and Leary in press).

Genetic Variation in the Grizzly Bear

Preliminary information on genetic variation in the grizzly bear was recently reported by Knudsen and Allendorf (1985). Tissue samples for genetic analysis were collected from 4 ecosystems in the United States and from 2 captive brown bears. Starch gel electrophoresis (with 4 electrophoretic buffer systems) was used to screen 48 enzymes for use in electrophoretic investigation of grizzly bear genetic variation. Seventy loci encoding 36 enzymes that could be screened for genetic variation were detected. Nineteen and 45 loci could be examined from blood and skeletal muscle samples, respectively.

While sample sizes were inadequate to estimate the amount of genetic variation either within or between populations, preliminary information was encouraging. One loci, Me, was genetically variable in samples from the Northern Continental Divide and Yellowstone ecosystems. The 1 bear sampled from the Cabinet-Yaak ecosystem was homzygous for an allele that was uncommon in the other 2 areas. This suggested that either this locus was also variable in the Cabinet-Yaak Ecosystem, or there were large genetic differences between this ecosystem and the other 2. Variation at another locus, Pgd, suggested substantial genetic divergence between Montana grizzly bears and grizzly bears from Alaska. Two captive Alaskan brown bears were homozygous for an allele not seen in any other wild bears.

Effective Population Size

The deleterious effects of inbreeding depression and genetic drift depend in part on the population's mating structure and distribution of offspring (Samson 1983, Schonewald-Cox et al. 1983). Geneticists developed the concept of a genetically effective population size, Ne, to assess the species-specific or population-specific effects of genetic drift and inbreeding. This can be defined as the size of an ideal population (numbers are constant, sex ratio is equal and all members make an equal contribution to each subsequent generation) in which the loss of genetic variability takes place at the same rate as in the actual population (Schonewald-Cox et al. 1983, Harris 1986c).

The principal factors used to assess the risk of extinction due to genetic changes are effective population size and time (Salwasser et al. 1983). Inbreeding depression is considered the most serious threat to short-term and genetic drift the most serious to long-term survival (Shaffer 1986). Based on breeding experiments, researchers have concluded that an *Ne* of approximately 50 is required to avoid deleterious inbreeding effects. Effective populations of about 500 are necessary for natural mutation rates to balance the loss of genetic variation due to genetic drift (Shaffer 1986). Following this reasoning, minimum viable population sizes equivalent to effective population sizes of 50 and 500 animals must be maintained to assure short-term survival and continuing adaptation, respectively (Shaffer 1986). Long-term evolutionary potential, or adaptability, may require substantially larger populations. The genetic variation of a large, well distributed population allows for continual adjustment to environmental change (Soule 1980).

Samson et al. (1985) developed a computer simulation model for grizzly bears that incorporated the effects of inbreeding depression, *F*, as a function of effective population size, *Ne*. The model was similar to Shaffer's (1978, 1981, 1983) in that population structure, age/sex specific reproductive and mortality rates and stochastic factors were considered. The simulation model was used to determine the change in *Ne* over a 100-year period for a hypothetical Yellowstone grizzly bear population with an initial *Ne* of 50. The stochastic model showed a continual decline in *Ne* until it equalled 0 at year 50. A deterministic version of the model showed *Ne* increasing for the first 25 years and then decreasing to 0 by year 75. The effects of migration on the inbreeding depression coefficient and effective population size were also examined. One individual entering the population every 5 years reduced the *Ne* needed to maintain a population (based on genetic considerations) to a negligible level.

The effective population size, *Ne*, of a grizzly bear population is always less than the number of animals in the population, *N*, because: 1) not all animals are of breeding age, 2) a few males dominate the breeding and 3) some adults have more offspring than others. Preliminary analyses suggest that *Ne's* of grizzly bear populations may be in the range of 0.2 N - 0.4 N (Harris 1986c).

The Grizzly Bear Recovery Plan (U.S. Fish and Wildlife Service 1982a) sets a threshold recovery level for the Cabinet-Yaak ecosystem of 70 bears. This corresponds to an *Ne* of 14-28 bears and an expected loss of genetic variation of 2-4% per generation or 9-17% of the total genetic

variation in 5 generations. These preliminary investigations suggest that loss of genetic variation may be a potentially serious problem for populations maintained at threshold recovery levels over a long time period (Harris 1986c).

Data concerning the effects of inbreeding depression on grizzly bear populations are insufficient to either validate or invalidate the general 50/500 rule of effective population sizes. Although the importance of genetic considerations for both short- and long-term viability of grizzly bear populations is recognized, demographic considerations may constitute the most direct threat to survival of these populations. The summary statements from the 1985 Workshop on grizzly bear population genetics stated that "... if there is a conflict in management between genetic and demographic considerations, demographic considerations should be paramount in the short-term (Harris 1986c)."

NUTRITIONAL REQUIREMENTS

Bears are the youngest family within the Order Carnivora (Colbert 1969). Over the course of evolutionary history, the *Ursus* line has followed a broad trend towards increased body size, longer claws, reduction of cheek teeth and replacement of carnassial shearing teeth with blunt bunodont molars (Colbert 1969). Bears also have the unspecialized digestive system of a carnivore, although somewhat lengthened (Davis 1964). The Ursidae have a cecum, not a rumen, that passes food through the digestive system relatively quickly. Few nutrients are extracted but bears compensate for this by a higher rate of passage (Hamer and Herrero in press a). These physical characteristics are clearly an adaptation to an herbivorous diet without sacrificing the ability to digest animal matter (Mealey 1977, Bunnell and Hamilton 1983). This flexibility has allowed Ursidae to exploit a wide variety of foods in numerous habitats.

Food habits studies in North America document the omnivorous diet of the grizzly bear. In all areas, vegetal matter comprises a dominant portion of the seasonal, if not annual, diet (Servheen and Wojciechowski 1978). Animal matter (e.g., fish, mammal, insect) is also consumed throughout the North American range in varying amounts. Although predatory behavior and efficiency varies within North America, digging of underground plant parts is a universal foraging trait suggesting that selection pressures are operating within *U. arctos* to enhance energy uptake (Bunnell and Hamilton 1983).

The quality and digestability of grizzly bear foods has received considerable attention in recent years. Foraging stategies in relation to food and habitat selection have been particularly prominent (Mealey 1977, Graham 1978, Sizemore 1980, Hamer and Herrero in press a). Craighead et al. (1982) and Knight et al. (1984b) have incorporated the nutritive quality of foods into models of habitat quality and prediction of habitat use.

Forage

During the early portion of their active season, grizzly bears tend to forage primarily on immature green vegetation or animal matter. Food plants at this time are in an early phenological stage of development and are high in soluble nutrients (Table 4) and low in lignin and cellulose (Hamer and Herrero in press a). Specific patterns of habitat use throughout North America are tied closely to the distribution of immature plant foods. Bears select habitats of specific elevation, aspect and moisture gradients to obtain these emergent succulent foods (Mealey 1977, Atwell 1980, Sizemore 1980, Stelmock 1981, Craighead et al. 1982, Hamer and Herrero 1983b, Hechtel 1985, Mace and Jonkel in press). Plants that generally appear early in the growing season, such as grasses, sedges, horestails and clover tend to be important foods until more nutritous foods become available (Craighead et al. 1982).

Green vegetation has also been documented as important during late seasons. Selection of vegetation at this time coincides with the use of mesic habitats such as stream bottoms and receding snowbed communities (Atwell et al. 1980, Mealey 1980, Hamer and Herrero in press a). Succulent vegetation in these mesic habitats have higher protein content than similar plant species in exposed areas (Graham 1978). The underground roots, corms and bulbs of foods such as *Herdysarum* spp., *Claytonia* spp. or *Erythronium* spp. are also selected at a specific time or in a specific habitat when nutrient quality is high and fiber content is low. Fiber in the diet may be of some benefit as ingestion of fiber may reduce the rate of food passage providing more opportunity for protein utilization (Stelmock 1981).

Insects

Insects such as ants are important diet items. Because of the monogastric nature of the digestive system, bears require certain amino acids and insect material may help meet this requirement (Eagle and Pelton 1983). Amino acids not used for synthetic purposes can be converted to metabolizable energy to help maintain homeostasis (Bumgarner 1979).

Fruit

Fruit is an important diet item in all areas as it provides bears with a superabundant source of sugar prior to denning (Hamer and Herrero in press a). During the period of fruit availabilty, bears must not only gain sufficient weight to survive denning, but must also store energy for the following spring. This is especially true for adult males that tend to forsake spring foraging opportunities to seek, find and mate with females (Sizemore 1980). During this period of fruit foraging, bears may consume nearly 20,000 kcal/day (Nelson 1980). Over-wintering berries are also consumed during the spring in some areas (Hamer et al. 1977, Hechtel 1985, Mace and Jonkel in press) and may have a higher sugar content than during the previous autumn (Hamer et al. 1977).

Several black bear studies have indicated that berry crop failures may be responsible for reproductive inhibition (Jonkel and Cowan 1971, Rogers 1977). Conversely, Mealey (1980) believed that periodic failures of berries or nut crops probably has no major impact in Yellowstone National Park because bears are "anchored to the more stable energy supply available from grasslands, herblands and associated forest edges."

Animal Matter

Because it is highly digestible and high in protein (Table 4) meat is often preferred over vegetal foods when available. Grizzly bear productivity and density in northern Alaska appears to be greatest in areas frequented by large numbers of caribou; this restricted availability of animal protein may limit grizzly populations (Phillips 1985). Small prey such as ground squirrels may be either a dietary supplement (Hamer et al. 1978, Stelmock 1981, Mace and Jonkel in press) or may constitute a major protein source prior to denning (Nagy et al. 1983, Hechtel 1985ab).

Table 4. Nutrient content and digestible energy of major grizzly bear food items (adapted from Knight et al. 1982).

	Nutrient Component					Digestible Energy	
			Nitrogen-free extract				
Food Item	**Protein**	**Fat**	**Sugar**	**Starch**	**Total**	**Gross Energy (kcal/g)**	**Digested Energy (kcal/g)**
Foliage:							
Trifolium spp.	19.7 [abdg]	3.6			52.6	3.2 [ab]	0.5
Taraxacum spp.	16.2 [cd]	6.2 [cd]			57.0	3.0 [k]	0.5
Epilobium spp.	22.3 [be]	2.6 [f]			50.3	3.0 [k]	0.5
Graminae spp.	13.1 [abce]	3.0 [abc]			54.5	2.9 [ab]	0.5
Equisetum spp.	14.8 [abcd]	3.9 [abcd]			49.6	2.8 [ab]	0.4
Claytonia spp.	29.0 [ac]	3.8 [ac]			45.2	4.0 [a]	1.2
Circium spp.	7.9 [abg]	1.0 [ab]			58.8	2.9 [a]	0.4
Heracleum lanatum	26.3 [j]	6.6 [j]					
Angelica arguta	13.8 [j]	5.3 [j]					
Roots:							
Lomatium spp.	8.3 [abd]	3.3 [abd]		34.3 [a]	73.4	3.2 [ab]	1.3
Polygonum spp.	9.0 [ab]	3.3 [ab]		43.3 [k]	73.4	3.2 [ab]	1.0
Perideridia gairdneri	4.1 [ab]	0.6 [ab]		40.1 [a]	88.2	3.8 [ab]	3.8
Fruits:							
Pinus albicaulis	13.0 [ab]	26.1 [ab]			21.8	4.0 [ab]	1.9
Vaccinium scoparium	8.3 [ab]	5.4 [ab]	40.0 [b]		69.9	3.8 [ab]	3.4
V. globulare	5.4 [bd]	4.9 [bd]	38.0 [b]		73.5	3.2 [b]	2.8
Shepherdia canadensis	11.2 [bc]	2.0 [bc]	34.0 [b]		76.7	3.3 [b]	2.9
Fragaria spp.	9.4 [ab]	5.6 [ac]	25.0 [b]		65.9	3.5 [ab]	3.1
Sorbus sitchensis	12.9 [j]	3.2 [j]					
Animal:							
Ungulates	88.2 [a]	6.7 [a]			0.1	5.6 [a]	4.6
Rodents	69.8 [a]	8.7 [a]			3.7	4.9 [a]	3.8
Cutthroat trout	72.3 [a]	15.3 [a]			4.3	5.7 [a]	4.1
Coho salmon	73.2 [i]	5.6 [i]					
Ants	43.8 [d]	15.4 [d]			27.0	4.8 [d]	2.7

[a] Mealey 1975
[b] Craighead et al. 1982
[c] Sizemore and Jonkel 1980
[d] Reinecke and Owen 1980
[e] Hamer et al. 1977
[f] Hamer et al. 1979
[g] Graham 1978
[h] Bunnell and Hamilton 1983
[i] Lloyd 1979
[j] Sizemore 1980
[k] estimated by relationship to other foods

MOVEMENTS AND BEHAVIOR

HOME RANGE AND MOVEMENTS

Home Range

Methods of Home Range Analysis

The minimum area polygon (Mohr 1947) is the most commonly used method of home range analysis in grizzly bear research. For purposes of comparison, only results using this method have been tabularized (Tables 5 and 6).

Because the minimum area polygon method assumes uniform distribution of habitat use (Samuel and Garton 1985), an assumption not satisfied by most bear home range data, some researchers have employed other methods of home range analysis. Harestad (1979) modified the minimum home range method of Mohr (1947) to allow stepwise deletions of the outermost relocation points for a given data set. Using this method, sub-areas which included 90% or 50% of the observed relocations for each bear could be determined (McLellan 1981, Hamilton 1982, Hamilton and Archibald 1984). Harvey and Barbour (1965) developed the "modified minimum area method" which used concave angles in connecting peripheral relocation points (Servheen and Lee 1979b, Kasworm 1984, Aune 1985). The exclusive boundary method, a grid method based on animal movement patterns (Stickel 1954), was modified for use with bears by Berns and Hensel (1972) and Reynolds (1976). The method of Jennrich and Turner (1969), which calculates home range area based on the determinant of the recapture point covariance matrix, was used by Sizemore (1980) and Harting (1985).

Geometric centers of activity can be determined from bear relocation data using the method of Hayne (1949). A standard diameter can be calculated for each relocation data set to delineate a circular area around the geometric center which incorporates 68% of all relocation points (Harrison 1958). Variations on this method of analyzing relocation data were used by Joslin et al. (1977) and Knight et al. (1979).

Home Range Size Comparison Between Ecosystems

It is difficult to directly compare grizzly bear home range data from different ecosystems and study areas since the methods used to calculate areas, sample sizes, duration of observations and intensity of relocations vary greatly among studies. The accuracy of home range determination is further complicated by the logistical difficulties in keeping functional radio transmitters on grizzly bears and other problems encountered in radiotracking (Nagy and Russell 1978). Substantial variation in individual foraging strategies, habitat use and, consequently, home range patterns (Simpson and Hebert 1982, Hamer et al. 1983, Harting 1985) can obscure between-population distinctions, especially when sample sizes are small.

Nonetheless, it is obvious that home range sizes vary widely both within, and between, ecosystems (Table 5). In general, though, the home range sizes of female grizzly bears are less variable than those of males. Home range sizes for both sexes (adults) are smallest in Southeast Alaska and on Kodiak Island. Home range size increases for bears from the Alaskan Peninsula, Interior British Columbia, the Northern Interior of Canada and the Coast of British Columbia, and is largest for bears from the Rocky Mountains of Canada and Montana, Yellowstone, the Alaskan and Canadian Arctic, South Central Alaska, the Boreal Forest in Alberta and the Cabinet/Yaak eco-sys-tem of Montana.

Seasonal Home Ranges and Habitat Relationships

The lifetime home range of a grizzly bear contains all the components necessary for its survival, although seasonal and annual home ranges may not (McLellan 1981). Use of areas within the lifetime home range depends on seasonal food availability, breeding activity and status and denning sites (Russell et al. 1979).

Craighead and Mitchell (1982) hypothesized that 2 types of populations exist: those in ecosystems having concentrated food sources (ecocenters), and those in ecosystems without food concentrations. Home ranges where ecocenters exist, often consist of 2 or more seasonal activity centers connected by a travel corridor (Craighead and Craighead 1972b). This pattern of discrete seasonal ranges was also evident in some populations lacking distinct ecocenters (e.g., Servheen and Lee 1979b). Reynolds (1976) and Murie (1981) noted that some bears remained in the same general area throughout the active seasons, whereas others shifted ranges with the "food season." Many authors recognized the importance of seasonal and annual food availability and distribution, and the presence of concentrated food sources (Glenn 1976, Nagy and Russell 1978, Bernes et al. 1980, Judd and Knight 1980, Mace and Jonkel 1980b, Spencer and Hensel 1980, Reynolds 1980, Servheen et al. 1981, Craighead and Mitchell 1982, Miller and McAllister 1982, Archibald 1983, Hamer et al. 1983, Knight et al. 1984b, Miller 1984, Aune 1985). Some examples of seasonal food sources that influenced grizzly movements and home range relationships included garbage dumps (Mundy and Flook 1970, Craighead and Mitchell 1982, Knight et al. 1984b), salmon spawning streams (e.g., Russell 1974, Atwell et al. 1980, Glenn and Miller 1980, Troyer 1980ab), berry concentrations (Mundy and Flook 1973, Pearson 1975, Wielgus 1986), pine nuts (Knight et al. 1984b), ungulate winter range (carrion) and calving areas (Quimby and Snarski 1974, Craighead and Mitchell 1982, Knight et al. 1984b), and lush sedge/forb meadows (Quimby and Snarski 1974, Atwell et al. 1980).

There is some evidence that home range size varies according to climate and annual food production. Mace and Jonkel (1980c), Sizemore (1980) and Picton et al. (1986) felt that climate or snow depth influenced home range size and shape. Knight et al. (1984b) found that home ranges, especially those of females, were smallest in optimal food years. Miller (1984) found an inverse correlation between home range size and berry crop success.

Mean annual home range sizes in the Yellowstone Grizzly Bear ecosystem increased rather dramatically between the studies of the Craigheads (1959-1970) and the Interagency Grizzly Bear Team (1974-1984) (Table 5). These increases were partially attributable to the closing of

Table 5. Mean minimum home range sizes (sq. km) of grizzly bears in major study areas. Minimum and maximum ranges are given in parentheses. Sample size, n, equals the Most ranges calculated by minimum area (convex polygon) method (Mohr 1947). number of "bear-years" (annual home ranges) used to calculate means: some bears may be represented more than once.

Ecosystem, Area and Citation	Home Range (sq. km) Adult Male	Adult Female	Subadult Male	Subadult Female	Comments
Yellowstone Ecosystem					
Whole Ecosystem (F. Craighead 1976)	233 (31,435) n=2	73 (18-275) n=4	126 (52-324) n=4	—	pre-dump closure (1959-70); annual ranges; adult = 5+ years
Whole Ecosystem (Knight et al. 1984b)	828 (189-2743)	384 [a] (28-1259)	468 (50-2185)	323 (70-580)	post-dump closure (1974-1984); annual ranges (>14 relocations); total sample size = 118; individual sample sizes not available; adult = 5+ years
Whole Ecosystem (Knight et al. 1984b)	1970 (754-3238)	874 (368-1463)	—	—	post-dump closure (1974-84); lifetime range (>60 relocations over 3 years); adult = 5+ years
Northern Continental Divide Ecosystem					
Mission Mountains (Servheen and Lee 1979b)	1398 (293-3029) n=3	133 (20,205) n=2	— — n=2	56	annual ranges; adult = 5+ years
South Fork of Flathead River (Mace and Jonkel 1979b, Mace and Jonkel 1980c)	286 (166-559) n=5	99 (94-104) n=2	261 (143-432) n=4		annual ranges; female with range = 104 sq. km. accompanied by 3 cubs; adult = 5+ years
South Fork of Flathead River (Sizemore 1980)	511 — n=1	158 — n=1	295 — n=1	155 — n=1	annual ranges; adult = 6+ years; female accompanied by 3 cubs; used method of Jennrich and Turner (1969)
North Fork of Flathead River (Rockwell et al. 1978)	463 (221-705) n=2	104 — n=1	618 — n=1	—	annual ranges; adult = 5+ years
Rocky Mountain East Front (Schallenberger and Jonkel 1980)	747 (280-1400) n=5	226 (171-305) n=3	566 (505-627) n=2	56 (39-73) n=2	annual ranges; adult = 5+ years
Rocky Mountain East Front (Aune 1985, Aune and Stivers 1982,1983,1985; Aune et al. 1984)	828 (388-1804) n=4	413 (175-735) n=17	1252 (235-2056) n=5	308 (196-374) n=5	annual ranges; adult = 5+ years
Cabinet/Yaak Ecosystem					
Cabinet Mountains (Kasworm 1984,1985)	1290 — n=1	430 — n=1	—	—	annual ranges; adult = 5+ years
Selkirk Mountains Ecosystem					
(Almack 1985)	—	402 (195-609) n=2	—	—	annual range of same bear from 2 consecutive years

Table 5. (Continued)

Ecosystem, Area and Citation	Home Range (sq. km) Adult Male	Adult Female	Subadult Male	Subadult Female	Comments
Canadian Rockies					
Akamina-Kishinena/ North Fork Flathead (McLellan 1981)	446 (215-679) n=5	200 (65-391) n=5	156 (153-159) n=2	48 — n=1	annual range; adult = 5+ years
Jasper National Park (Pearson and Nolan 1977)	535 (482-588) n=2	201 (189-212) n=2	—	—	annual range; adult = 5+ years
Jasper National Park (Russel et al. 1979)	916 (189-1628) n=11	224 (89-358) n=2	633 (33-1233) n=2	109 (33-185) n=2	annual range; adult = 6+ years; subadults with range = 33 sq. km. were orphaned siblings
Kananaskis Country (Wielgus 1986)	92 (104-2110) n=8	133 (36-345) n=10	575 (444-683) n=3	82 (46-128) n=4	male ranges are multiannual; female ranges are mean annual range; adult = 5+ years
Interior British Columbia					
Revelstoke Area (Simpson et al. in prep)	297 (130-512) n=7	79 (42-2098) n=3	125 — n=1	—	annual ranges; adult = 6+ years
Northern Interior					
SW Yukon: Kluane National Park (Pearson 1975)	287 — n=5	86 — n=8	70 — n=3	88 — n=4	annual ranges; adult = "mature"
Boreal Forest					
Swan Hills, Alberta (Nagy and Russell 1978)	1022 — n=1	425 — n=1	82 — n=1	140 — n=3	annual ranges; adult = 6+ years
Canadian Arctic					
Northern Yukon (Nagy et al. 1983a)	286 (8-1352) n=17	121 (7-701) n=24	841 (10-1898) n=4	36 (2-78) n=5	annual ranges; adult male = 8+ years, adult female = 6+ years
Northwest Territories: Tuktoyaktuk Peninsula/ Richards Island (Nagy et al. 1983b)	875 (81-1943) n=10	514 (42-2098) n=4	1516 (156-2631) n=4	20 (9-40) n=3	annual ranges; adult male = 7+ years, adult female = 6+ years
Arctic Alaska					
Eastern Brooks Range (Reynolds 1976)	702 —	382 —	— n=5	— n=3	annual ranges; adult = 8+ years
Western Brooks Range (Reynolds 1978; Reynolds and Hechtel 1980)	776 (746-1927) n=4	220 (80-873) n=37	142 — n=1	113 (104-122) n=2	annual ranges; subadult ≤4 years
Interior Alaska					
Alaska Range (Reynolds and Hechtel 1983a)	710 (202-1476) n=6	132 (26-556) n=6	23 (21-26) n=2	65 (16-184) n=6	annual ranges; adult = 6+ years

Table 5. (Continued)

Ecosystem, Area and Citation	Home Range (sq. km) Adult Male	Adult Female	Subadult Male	Subadult Female	Comments
Southcentral Alaska					
Cooper River Delta (Campbell 1985)	295 (240-349) n=2	174 (97-261) n=4	316 — n=1	203 (144, 262) n=2	annual ranges; female with home range = 97 sq. km accompanied by yearling; adult = 5+ years
Nelchina/Upper Susitna basins (Miller and Ballard 1980)	850 (496-1252) n=6	415 (222-734) n=4	848 (282-1038) n=4	118 — n=1	annual ranges; adult = 5+ years
Susitna Hydro Project (Miller and McAllister 1982; Miller 1984)	1014 (100-2135) n=10	294 (110-536) n=15	1218 (88-2655) n=14	320 (131-712) n=17	annual ranges; adult = 5+ years
Alaska Peninsula					
(Glenn and Miller 1980)	262 (62-749) n=4	293 (26-1098) n=30	749 (111-2109) n=5	244 (104-420) n=6	annual ranges; adult = 9+ years, subadult = 2-4 years
Kodiak/Afognak					
Karluk Lake (Berns et al. 1980)	24 (3-49) n=7	14 (9-20) n=6	—	—	annual ranges
Terror Lake Hydro Project: 1982 (Smith and Van Daele 1984)	230 (82-465) n=8	26 (6-94) n=16	51 (30-77) n=4	—	annual ranges for bears with ≥5 relocations; adult and subadult females combined; minimal construction activity
Terror Lake Hydro Project: 1983 (Smith et al. 1981)	119 (33-327) n=10	31 (7-157) n=26	99 (12-68) n=6	—	annual ranges for bears with ≥5 relocations; adult and subadult females combined; expanded construction activity

garbage dumps, which once served as "ecocenters" in Yellowstone National Park (Judd and Knight 1980). Knight et al. (1984b) noted that home range sizes for 3 grizzly bears were inversely proportional to the intensity with which they foraged at a garbage dump in Cooke City, Montana (on the northeast park border).

The influence of topographic structure and diversity on home range size and shape was noted for several areas (Curatolo and Moore 1975, Pearson 1977, Schallenberger and Jonkel 1978b, Lloyd 1979, Judd and Knight 1980). Pearson (1977) reported that in the southwestern Yukon, the greatest bear densities and smallest home ranges were found in areas with the most rugged terrain and the highest habitat diversity. He hypothesized that social intolerance regulated grizzly bear numbers and in diverse, rugged areas there was less chance for 2 bears to confront one another. Lloyd (1979) found that home range shape and size in coastal British Columbia was determined by topography. Judd and Knight (1980) suggested that the large home ranges in Yellowstone relative to the high mountain ecosystems may be due to its plateau topography.

Home Range Overlap and Territorial Defense

Craighead and Mitchell (1982) hypothesized that in Yellowstone National Park the lack of territorial defense and the great degree of home range overlap among sex and age classes of grizzly bears related to a social linear hierarchy that permitted freedom of travel and, therefore, the ability to maximize exploitation of rich food sources. Extensive home range overlap among all sex and age classes was also noted by Lloyd (1979), Ballard et al. (1982b), Nagy et al. (1983b) and Servheen (1983). Others noted that there was overlap, but not of core areas: that is, that geometric activity centers were well spaced (Martinka 1970 [adults of same sex], Russell et al. 1979, McLellan 1981 [females only], Aune et al. 1984 [females]). Mace and Jonkel (1980c) found that the degree of overlap between male and female home ranges was 41%, but only 14% overlap between different males. Murie (1981) noted varying degrees of home range overlap, but also observed that bears avoided close contact with more dominant bears. Archibald (1983) reported that home ranges tended to be exclusive "where food sources are evenly distributed and predictable." There is some evidence that subdominant bears (females and subadults) were relegated to high elevation, suboptimal habitat, whereas mature males frequented the most productive lower elevation areas (Nagy and Russell 1978, Russell et al. 1979, Wielgus 1986).

Movement

Grizzly Bear Movement Patterns

Mobility is an important aspect of grizzly bear feeding ecology (Hamer et al. 1983). Quimby and Snarski (1974) documented four kinds of movements by grizzly bears: (1) movement to an abundant or preferred food source, (2) localized movement, (3) intensive feeding prior to denning and (4) movement to a den site.

Rates of movement, as reported in the literature, are moderate when averaged per day (e.g., for adult males, 1.34 km/day and 4 km/day as reported by Knight et al. [1984b] and Reynolds [1980], respectively). However, there are reports of grizzlies making extensive movements in relatively short time periods (e.g., 26 km in 10 hours, [Linderman 1974] and 54 km in 62 hours, [Craighead 1976]).

Grizzly bear movements may be abrupt, rapid or direct. Craighead and Mitchell (1982) found that movements to fall foraging sites and the final movements to den sites were often abrupt and rapid. Ruttan (1974) found that bears in Northern Canada moved directly to the Arctic Coastal Plain after den emergence and made the reverse movement back in September. Almack (1985) observed long, direct, treks to specific food sources and to den sites.

Grizzly bear movement may also involve indirect travelling as bears forage for widely dispersed food items. Knight et al. (1984b) found that summer movements consisted largely of a wandering search pattern because food sources were scattered at that time. Hechtel (1978) and Archibald (1983) hypothesized that grizzly bear movements reflected a random search pattern in order to increase the probability of encountering high energy animal food sources. Several authors reported that spring movements were greatest relative to other seasons due to the dispersed, patchy nature of food sources at this time (Glenn 1975, Lloyd and Fleck 1977, McLellan 1982, Aune et al. 1984). Wielgus (1986) found that spring movements of females were closely tied to vegetative food items, whereas males were seeking carrion and elk calves.

Grizzly bears often exhibit discrete altitudinal movements from spring to fall, following seasonal food availability (Mundy and Flook 1973, Russell 1974, Pearson 1975, Valkenburg 1976, Servheen and Lee 1979b, Spencer and Hensel 1980, Zager 1980b, B.I.A. 1981, Martinka 1981, Smith and Van Daele 1984). For example, Valkenburg (1976), Mundy and Flook (1973) and Martinka (1971) described the following pattern; after den emergence, grizzly bears moved down in elevation to feed on the first green vegetation and winter-killed ungulates, later moved up in elevation to forage on fresh vegetation in avalanche chutes and alpine zones, and in late summer and fall, moved down to feed on spawning salmon or berries.

Differences in Movement Patterns and Home Range Size According to Age, Sex and Reproductive Status

Most studies of grizzly bear movement patterns have shown that males have larger home ranges and move greater distances than do females (Table 5). Generally, the large home range and movements of males is thought to result from spring breeding behavior; it is advantageous for a mature male's home range to encompass several home ranges of estrous females, and wide-ranging movements increase the probability of encountering receptive females (Bunnell and Tait 1981, Russell et al. 1983, Knight et al. 1984b, Smith and Van Daele 1984). Another explanation is that males, having the larger body size, and hence greater energy needs, require a larger area for sustenance than do females (Harestad and Bunnell 1979). For example, Schoen and Beier (1983) found that male grizzly bears tended to forage along more than 1 salmon stream, whereas females tended to remain in 1 drainage during salmon spawning.

Reasons given for small female home ranges include: (1) that it is advantageous for a female to lessen her chances of encountering an aggressive male (Curatolo and Moore 1975) and, (2) that young females tend to remain on maternal home ranges and maintain an attachment to an area of familiarity (Pearson 1975). This may be supported by the observation that females in some areas showed more year-to-year fidelity to a specific geographic area (Murie 1981, Nagy et al. 1983ab, Knight et al. 1984b, Smith and Van Daele 1984). Furthermore, habitat selection by females with young may be constrained by the need for security. Patterns of habitat use segregation observed in several areas suggested that isolation from other adults was a factor in habitat selection by family groups (e.g., Pearson 1975, Gebhard 1982, Nagy et al. 1983, Stelmock, Knight et al. 1986).

Table 6 compares the home range sizes of females of different reproductive status. Many authors reported that home ranges of females accompanied by cubs of the year were smaller than those females accompanied by yearlings (Pearson 1974, Atwell et al. 1980, Berns et al. 1980, Glenn and Miller 1980, McLellan and Jonkel 1980, Miller and McAllister 1982, Smith and Van Daele 1982, Knight et al. 1984, Miller 1984, Aune 1985, Barnes 1985, Wielgus 1986). The enlarged home ranges of females accompanied by yearlings or 2-year olds (relative to solitary females and females with cubs of the year) may be due to increased nutritional demands, greater mobility and "training" of the young bears (Hamer et al. 1978, Knight et al 1984b).

Conversely, Servheen (1983), Hamer et al. (1983) and Reynolds (1978) reported that home ranges for females were largest when they were accompanied by cubs of the year. McLellan (1981b), Ballard et al. (1982b), Miller et al. (1982), and Curatolo and Moore (1975) reported no significant difference in the size of the home range for females of different reproductive status.

Dispersal of Subadults

Generally, subadult males disperse out of the maternal range (Glenn 1980, Nagy et al. 1983a, Knight et al. 1984b, Miller 1984), and establish a separate home range coincident with the onset of breeding activity (Servheen and Lee 1979b, Knight et al. 1984b). Home range size gradually increases with reproductive success and new food experiences (Craighead 1980), and may become twice the size of the maternal range (Knight et al. 1984b).

Reynolds and Hechtel (1983) observed 1 subadult (of 3), and Miller (1984) observed 1 (of 5) subadult males which remained in the maternal home range. However, most research showed that subadult males dispersed long distances (Glenn 1980, Craighead and Mitchell 1982, Reynolds and Hechtel 1983ab), as reflected in the relatively large home range sizes for this age/sex class (Table 5). Establishment of a separate home range is related to the availability of suitable habitat (Martinka 1970, Nagy and

Table 6. Mean annual home range size (sq. km) for adult females of different reproductive status. Most ranges calculated from minimum area (convex polygon) method (Mohr 1947).

Ecosystem, Area and Citation	Reproductive Status	Home Range Size (sq. km)	Sample Size[a]
Yellowstone Ecosystem			
(Knight et al. 1984b)	single	424	8
	cubs	225	9
	yearlings	546	7
Canadian Rockies			
Banff Natl. Park	single	149	b
(Hamer et al. 1983)	cubs	193	
	yearlings	195	
	2-yr olds	206	
Kananskis country	single	147	4
(Wielgus 1986)	cubs	122	4
	yearlings	126	2
Canadian Arctic			
Northwest Territories	single	513	14
(Nagy et al. 1983b)	cubs	239	5
	yearlings	507	10
	2-yr olds	726	2
Arctic Alaska			
Western Brooks Range	single (breeding)	194	4
(Reynolds and Hechtel 1980)	single (non-breeding)	290	14
	cubs	220	5
	yearlings	133	7
	2-4 yr olds	197	5
Eastern Brooks Range	single	382	3
(Reynolds 1976)	with young	280	5
Interior Alaska			
Alaska Range	single	167	4
(Reynolds and Hechtel 1983a)	with young	51	7
Southcentral Alaska			
Susitna Hydro Project Phase I: minimal construction	cubs	230	4
(Miller and McAllister 1982)	yearlings	168	2
Phase II: increased construction	cubs	642	11
(Miller 1984)	yearlings	625	4
Nelchina/Upper Susitna	single	364	7
(Miller and Ballard 1980)	with young	568	4
Kodiak/Afognak			
Karluk Lake	single	14	6
(Berns et al. 1980)	with young	11	17
Kodial Natl. Wildl. Refuge	single	21	
(Barnes 1985)	cub	32	22
	yearlings	57	
Terror Lake Hydro. Project	cubs	17	4
(Smith and Van Daele 1984)	yearlings	46	7
(Smith et al. 1984)	cubs	8.5	1
	yearlings or other	31	7

[a]Number of home ranges, not number of bears.

[b]Same bear; 4 years data.

Russell 1978, Miller and McAllister 1982), or the attainment of social status necessary to occupy the home range of an adult that dies (Martinka 1970, Russell et al. 1979).

Subadult females often establish a home range encompassing some portion of the maternal range (Pearson 1975, 1977, Glenn 1980, Nagy et al. 1983b, Reynolds and Hechtel 1983ab, Knight et. al. 1984b, Miller 1984, Wielgus 1986). Movement and home range size of subadult females is often smaller than all other sex and age groups (B.I.A. 1981, Craighead and Mitchell 1982). Knight et al. (1984b) documented that home range increases between weaning to reproductive age when it contracts, then increases and contracts cyclically according to annual food availability and reproductive status.

Few authors speculated as to why there is a tendency for young males to disperse and young females to stay within the maternal home range. Wielgus (1986) and Craighead and Mitchell (1982) noted that adult sows and dominant males directed more aggression toward young males than toward young females. There is also some theoretical basis for adult male aggression being directed primarily at other males (Bunnell and Tait 1981). Thus, interference by resident adult males could disproportionately affect movements and home range use of other males, especially juveniles. Craighead et al. (1964) hypothesized that male dispersal was partially a function of population density.

Waser and Jones (1983) suggested that dispersal may be selected for if it increased an individual's chances of encountering members of the opposite sex, produced more heterozygous offspring (avoided inbreeding) or gave access to empty but suitable habitats. In most of the vertebrate species they reviewed, females were least likely to leave the parental area. For bears, a female can promote reproductive success of her female offspring by enhancing growth and the attainment of sexual maturity. This is less true for male offspring which need a large area to find and inseminate several females in order to maximize their reproductive success. Other factors which may be important in favoring subadult females' continued residence on the natal home range are the potential opportunity for inheriting the parental home range, habitat saturation (i.e., no empty suitable habitat exists), and the advantage of being familiar with an area in terms of foraging efficiency (Waser and Jones 1983).

ACTIVITY PATTERNS

Activity patterns refer to the diel rhythms of activity and inactivity displayed by grizzly bears. These patterns can be discerned by direct observation (e.g., Stelmock 1981, Gebhard 1982), radio-telemetry (e.g., Sizemore 1980), or motion-sensing radio collars (e.g., Schleyer 1983, Harting 1985). Several researchers included discussions of the attendant behaviors (e.g., travelling, foraging, resting) with their analysis of temporal activity patterns.

Activity patterns of a species are of interest for several reasons (Roth 1983). Once the activity patterns have been quantitatively described for various environmental conditions, the pattern observed for a given population could possibly help to interpret the level of stress experienced by that population. Insight into the activity regimes for a given population might also help to reduce the potential for undesirable bear-man encounters and to promote better research schedules for censuses, etc.

Yellowstone Ecosystem

Schleyer (1983) used motion-sensing telemetry collars to study grizzly bear activity patterns in the Yellowstone ecosystem. He found that the bear activity level (number of minutes active per half-hour time block) varied greatly with time of year (month and season), time of day, food source and individual bear.

Four weather factors had significant effects on the activity level. Temperature explained a significant portion of the variation but the relationship varied seasonally. Annually, the by temperature response curve was roughly bell-shaped with highest activity from 5.6 - 11 C and above 22 C. Changes in relative humidity were significantly related to activity level. Activity increased with relative humidity until it reached 95% at which point activity diminished slightly. The type of precipitation, or lack of it, was significantly related to activity level. Hail impeded activity while fog appeared to enhance activity. Bears were less active than average when there was no precipitation and slightly more active than average during rain. Lunar phase also explained a significant portion of the variance in activity level, grizzlies were most active under intermediate light levels.

Harting (1985) also studied the activity patterns of grizzly bears in Yellowstone. Like Schleyer (1983), he found that temperature had a significant effect on bear activity levels. Peak activity was in the 10 - 15 C range with lower activity at both temperature extremes. Unlike Schleyer's (1983) results, Harting (1985) reported that bears were most active when there was no precipitation. The effects of wind speed and cloud cover were inconclusive. The probable effects of these environmental variables on foraging efficiency were also discussed.

Schleyer (1983) reported that grizzlies were least active (about 2.4 - 4.8 hours/day) during the 2 months prior to denning (September and October) and immediately following den emergence. Activity during the summer months was high and fairly constant at 8-12 hours of activity during any 24-hour period. Harting (1985) also found high activity during the summer months and lower activity in the fall. The low fall activity level was attributed to predation and feeding on carcasses by the monitored bears. Schleyer (1983) also reported that grizzly bears were significantly less active while using a carcass than at other times, however, Harting (1985) reported that grizzly activity levels were lowest during May while Schleyer (1983) found that grizzly activity was highest in May.

Schleyer (1983) reported that annually, Yellowstone grizzly bears were somewhat nocturnal with crepuscular activity peaks at 0630 and 2400 and very little activity from 1030 - 1830. Grizzlies were basically crepuscular in all 3 seasons with increased diurnal activity evident in spring. The fall activity pattern was fairly erratic as grizzlies fed primarily on ungulate carcasses.

Harting (1985) also found that Yellowstone grizzly bears were most active during the crepuscular periods and significantly less active during the day than during any other period. Primary activity peaks occurred at 0500 and 2200 with lower activity from early to mid-afternoon. Seasonal

differences in activity patterns were discussed but data were limited.

Gunther and Renkin (1985) presented data on grizzly bear activity patterns in the Pelican Valley of Yellowstone National Park. Activity levels were determined from direct observation of bears during the summer season. Major peaks in activity occurred at 0630, 1000 and 2030. Activity quickly declined after 1000 with very low activity from 1230 - 1500, gradually increasing until the peak at 2030. This crepuscular pattern basically follows that discussed above.

Both Schleyer (1983) and Harting (1985) reported that grizzly bear activity patterns varied significantly by individual bear. One of the 5 grizzlies monitored by Schleyer (1983) appeared to be diurnal to crepuscular with very little nocturnal activity except during the summer. Harting (1985) discussed the correlations between the observed differences in diel activity patterns, foraging behavior and habitat use for individual grizzlies. His preliminary data suggested a substantial interdependence among these variables.

Schleyer et al. (1984) studied the effects of nonmotorized recreation on grizzly bear activity patterns and habitat use in the Yellowstone ecosystem. Activity patterns were determined during pre- and post-disturbance periods with the aid of motion-sensing radiocollars. Non-disturbed grizzlies were basically crepuscular with an early morning activity peak (1 bear was somewhat diurnal). Disturbed bears displayed a similar pattern but the activity level during 4 of 6 periods was elevated.

Northern Continental Divide Ecosystem

Sizemore (1980) found that the diel rhythms of 4 grizzly bears in the North Fork of the Flathead River Valley varied by season. All bears were more active at night than during the day for the spring-summer period but in the summer-fall period there was no difference between nocturnal and diurnal activity levels and the spring-summer activity level was significantly less than the summer-fall activity level. Monitored bears were active during all hours of the day during the latter period. A 5-year-old male was significantly more active during the day for the spring-summer period than either a 4-year-old female or an adult female with cubs. There were no significant differences by age/sex class for the summer-fall period.

Aune and Stivers (1985) and Aune et al. (1984) discussed the activity patterns of 4 bears along the Rocky Mountain East Front of Montana. Observations were collected during July and August as grizzlies fed primarily on berries. They reported that grizzlies became fully active between 2100-2400 hours after an awakening period of "stationary activity" in the twilight and evening hours. Bears remained active (feeding and travelling) until 0600-0900 hours. The researchers noted that the same bears behaved differently in different locales. Grizzlies were more crepuscular in mountainous or isolated terrain than in populated foothills or plains.

Shaffer (1971) discussed the activity patterns of grizzly bears feeding on huckleberries in Glacier National Park. Based upon direct observations and fresh field sign, he concluded that grizzly activity was concentrated in 2 periods of 0400-1100 and from 1530 until after dark.

Selkirk Mountains Ecosystem

Almack (1985) collected activity data from a collared adult female in the Selkirk Mountains of northern Idaho. In spring, the bear was mostly crespuscular. In summer, she was slightly crespuscular but often remained active for 24-hour periods. During the fall, she was often active for several hours during the day and inactive for most of the night.

Arctic Alaska Ecosystem

Gebhard (1982) studied the activity patterns of a grizzly bear family (sow and 2 yearlings) in the Brooks Range of Alaska. He reported that the family's activity level increased from about 14 hours/day in spring and summer to 20 hours/day by late fall. In spring, activity peaks occurred in early morning, mid-day and evening. Most of the active time was devoted to foraging for roots. The family alternated between periods of rest and activity which were quite variable in duration. By late summer, the active and inactive periods were longer and more continuous. The family was most active in the early morning and evening with little or no activity in mid-to late afternoon. About 80% of the sow's active time was spent feeding, with grazing being the dominant feeding activity. By early to late fall, the afternoon slump in activity diminished and the overall activity level increased. Foraging activities included digging for ground squirrels, digging for roots and grazing. Nocturnal observations were limited but the researcher felt that the family was probably active for much of the night.

Hechtel (1985) collected activity data from 5 female grizzly bears (4 with cubs) in the same general area of the western Brooks Range. As in most other studies of bear activity patterns (Stelmock 1981, Roth 1983, Schleyer 1983, Harting 1985, Phillips 1985), he found considerable variation among bears. Direct observation showed that 3 females with cubs were active for 20-40% (4.8 - 9.6 hours) of the 24-hour periods just after den emergence. The level of activity of 1 female after leaving the den area was in the 46-58% range. The author noted that this pattern of activity was consistent with the 4 physiological stages described for bears by Nelson et al. (1983a).

Hechtel (1985) also described the activity pattern of a female before and after initiation of breeding activity. During the pre-breeding period the sow (accompanied by 2 3-year-olds) was active an average of 56-74% of the monitored 24-hour time blocks. After expelling the cubs and pairing with a large male, she was active only 21% of the time. Murie (1981) and Phillips (1985) also reported that mated pairs spent less time foraging during the breeding season but some studies reported that activity patterns of breeding pairs were similar to other groups (Pearson 1975, Stelmock 1981).

Phillips (1985) studied the behavior patterns of grizzly bears in the Arctic National Wildlife Refuge of northeastern Alaska. As observed in most other studies of grizzly bear activity patterns, grizzlies in this study were most frequently active from early evening to early morning with crepuscular activity peaks. Phillips concluded that bear activity patterns were a response to the differential distribution (temporally and spatially) and size of important food items and fall hyperphagia. In spring, grizzlies fed on roots, ground squirrels and overwintered berries. These

food items were small and widely dispersed and required prolonged foraging for satiation. Grizzlies also spent more time travelling in spring than during other seasons. The observed grizzlies were active 100% of the time. In summer, grizzlies were active for 71% of the observation time as they fed primarily on herbaceous vegetation which could be ingested in large quantities over a short period of time. In fall, grizzlies were active for 79% of the observation time. During this time, the small, widely dispersed arctic ground squirrels were the major diet item. Spring and fall sample sizes were very small, and therefore, not conclusive.

Lindermann (1974) monitored the activity patterns of an adult male grizzly during spring in the eastern Brooks Range of Alaska. For all days combined, the bear spent 31% of his time feeding, 59% resting and 10% travelling. He tended to feed most often in the morning and rest more in the evening and night than in the morning. This result is in contrast to most of the studies discussed previously which also documented an evening activity peak. Magoun (1976) observed grizzlies as they fed on carcasses in the eastern Brooks Range. He reported that grizzlies fed more than expected from 0500-0600 and 1805-2400, less than expected from 0605-1200 and about as expected from 1205-1800.

Interior and Central Alaska Ecosystem

Stelmock (1981) studied the activity patterns of grizzly bears in Denali National Park by direct observation. Like Gebhard (1982), he found that activity peaks were generally crepuscular. Diurnal inactivity peaked around midday during spring and summer with shorter rest periods in mid-morning and early evening. The time spent resting diurnally decreased during late summer. Feeding activity during spring and summer consisted primarily of grazing, excavating roots and feeding on over wintered berries. As day length decreased in the fall, diurnal activity increased. Grizzlies foraged almost continuously as they fed on ground squirrels and berries.

Several studies documented bear activity along Alaskan salmon streams. These studies indicated that peak activity generally occurred in the evening with some fishing in the early morning and late afternoon periods (Erickson 1963, Troyer and Hensel 1969, Stokes et al. 1981). Nocturnal observations were limited but Troyer and Hensel (1969) felt that feeding activity continued for several hours into the night and then diminished before dawn. Stokes et al. (1981) found some evidence of social regulation of activity patterns. Dominant bears were active at the most productive fishing times and other bears were relegated to less productive periods.

Northern Interior (Yukon) Ecosystem

Unlike most of the other studies discussed above, Pearson (1975) found that there were no seasonal changes in the daily rhythms of grizzly bears in the southwestern Yukon. Moderately high, early morning activity was followed by low activity from 1100-1500. Activity increased in the late afternoon, reached a peak at dusk and, as evidenced by trap disturbance, continued into the night. Some age, sex and reproductive class distinctions were noted. Older males appeared to feed more purposefully and rest more often than other bears. Sows with young had activity patterns similar to other bears but moved more during daylight when feeding in areas of high grizzly concentration.

INTRASPECIFIC BEHAVIOR

Dominance Hierarchies at Dumps and Spawning Streams

Grizzly bears generally show a low degree of social organization but may form loose social aggregations at sites of plentiful food. At these sites, grizzly bear behavior assumes the characteristics of more gregarious species. This social organization enables adaptation to fluctuating environmental conditions and permits efficient use of the available resources (Hornocker 1962, Egbert and Stokes 1976, McArthur 1979c, Herrero 1978b, Bunnell and Tait 1981).

Detailed studies of grizzly bear dominance hierarchies have been conducted at Yellowstone garbage dumps (Hornocker 1962) and at Alaskan salmon spawning streams (Stonorov and Stokes 1972, Egbert and Stokes 1976, Luque and Stokes 1976, Egbert 1978, Luque 1978, Stokes et al. 1981).

Hornocker (1962) identified 5 classes of adult male grizzlies at the Trout Creek dump in Yellowstone National Park. These are:

Dominant male — One male held the dominant position at the dump during all 3 years of the study. Dominance was gained by actively seeking and defeating "aggressive" males (see below). Approach of this male elicited a strong avoidance reaction by all bears except the aggressive males and females.

Subdominant male — This class was recognized for only 1 year of the study and describes 1 adult male which was persistently aggressive toward the dominant male and other adult males. When the dominant male was absent, this male assumed the dominant position.

Aggressive males — This class, comprised of 2 to 4 adult males, referred to the third tier in the "ruling class" of adult males. Overt aggressiveness, rather than size or age was the primary factor determining relative rank. A definite peck order existed within this class and these males were intolerant of all other bears below their rank except for "aggressive females."

Defensive males — These males avoided the aggressive males, but would fight when surprised or cornered. These males appeared to be younger than the aggressive and dominant males but often equaled them in size. Fighting within this class was rare and these bears were more tolerant of lesser individuals than were the aggressive males.

Cautious males — These males, smaller and generally younger than males of the above classes, were aggressive only toward inferior classes.

Female position in the social hierarchy varied according to aggressiveness, reproductive condition, age and size. Hornocker (1962) identified 3 classes of adult females. These are:

Aggressive females — Some females with cubs of the year were subordinate only to the Dominant Male and those males immediately below him. These females demonstrated extreme hostility toward all dominant adult males and did not hesitate to attack even the adult male. This hostility was apparently related to protection of their offspring.

Defensive females — Females with cubs of the year and females with yearlings that avoided contact with superiors were included in this group. These females, generally younger than the aggressive females, protected their young by warning them away from males and through bluff rushes rather than actual physical contact.

Cautious adult females — This class included all adult females without young. These females avoided aggressive males at all times but ignored smaller males. Aggressiveness, size and age determined the social rank of these females.

The behavior of younger bears was sufficiently different from that of adults to warrant their placement in a separate dominance class — the subordinate class. Three subclasses of younger bears were identified (Hornocker 1962). These were:

Young adults — Age (3 and 4 years) was responsible for these bears' inferior status relative to other bears, while size determined the individuals' status within the class. Individuals within this class displayed a much wider range of aggressive-submissive behavior than any other class.

Two-year-olds — These bears exhibited behavior similar to the young adults. Those still with litter mates held a somewhat higher position than lone individuals since litter mates often joined forces in attempted bluffs against superior bears.

Weaned yearlings and orphans — These bears, the lowest members in the dominance structure, were physically inferior relative to other bears. They were very secretive and ran at the approach of other bears.

The social hierarchy observed by Egbert (1978) and Egbert and Stokes (1976) on the McNeil River, Alaska, was similar in many respects to the system described by Hornocker (1962), however, they found that status relationships were somewhat variable and were often interpretable only in a relative sense. The status ranking of classes varied by year; i.e., tallies of the number of encounters "won" or "lost" by each age/sex class showed marked, between-year, differences.

As in Yellowstone, adult males were the most dominant and aggressive age/sex class. A single "alpha" bear was dominant over all other bears. Unlike Yellowstone, the alpha male was firmly entrenched and was never seriously challenged by other males. Other adult males were next in the hierarchy and had priority over the best fishing locations during the most productive times of day.

Again, as was found in Yellowstone, females with young were particularly aggressive and were the only bears to consistently challenge adult males. During the second year of the study, the salmon run was higher than in the first year and more salmon were available to bears in areas other than at McNeil Falls. Fewer females with young were present at the falls this year, suggesting that when fish were plentiful, these females preferred more secure habitat away from the bear concentrations. In an earlier study at McNeil Falls, Stonorov and Stokes (1972) noted that 3 females with cubs also avoided the falls. Erickson (1965) reported that in peak fish years fewer bears congregated at the Falls and these were mostly large males and single females. Single adult females (equivalent to Hornocker's "cautious adult females") were more tolerant of other bears than were females with young, however, there was much variation within this class.

Adolescent males (4.5 - 8.5 years) were the least aggressive of any group and were never observed initiating an aggressive encounter. Adolescent females (4.5 - 5.5 years) behaved much like single adult females. Adolescents of both sexes engaged in a greater number of non-agonistic encounters (amicable or playful contact) than did other groups. Subadult (2.5 - 3.5) bears occupied the lowest position in the social hierarchy, typically avoiding contact with other bears and forced to patrol for salmon scraps along the periphery of the main fishing areas. Stonorov and Stokes (1972) reported that some subadults were so intimidated that they would lay by a good fishing spot but not fish.

At both Yellowstone and McNeil River, the primary benefits of high social status related to food and breeding activity. Hornocker (1962) reported that dominant individuals were more successful at obtaining food both at the dump and in backcountry areas, therefore, in years of food scarcity, these individuals would be at an advantage. At McNeil River, the main advantage of social status was determining the place and time to fish without conflict (Egbert and Stokes 1976). The link between food access and aggressive behavior was most evident late in the summer when agonistic encounters increased as fishing success declined. Aggressive encounters declined by 50% and non-agonistic encounters increased during the second year of the study when salmon were more plentiful. Stonorov and Stokes (1972) reported that competition for a choice fishing spot was 1 of 4 situations that released aggression. Violation of individual distance, redirected aggression following loss of an encounter and meetings of unfamiliar bears also caused aggression.

Evidence linking dominance to reproductive success was inconclusive. Hornocker (1962) found that the dominant male mated and defended only 1 female in all 3 years of his study. Although aggressive males were more successful in the competition for breeding females, males near the top of the dominance hierarchy did not dominate the breeding activity. Some cautious males were more active in the reproductive effort than were their superiors. Aggressive males sometimes lost possession of female consorts while engaged in fights to defend her. At McNeil River, the alpha male was observed to attack and dislodge a copulating subordinate male (Egbert and Stokes 1976). However, estrous females displayed an apparent preference for mature, but relatively small, adolescent males as opposed to the larger, more threatening adults.

In both study areas, aggression increased during the breeding season. Egbert and Stokes (1976) found that all males, regardless of social status, were highly aggressive when associating with adult females. Hornocker (1962) reported that in all 3 years of his study, aggressive behavior by the dominant male toward all bears except adult

males, dropped dramatically on the day following the last observed breeding activity.

Social Relationships in Dispersed Populations

Social relationships observed in backcountry and low density areas differred somewhat from the patterns described above for high densities. Many researchers reported that mutual spacing or detection followed by avoidance, was the norm for backcountry populations (e.g., Martinka 1974a, 1974c, 1976, Pearson 1975, Stelmock 1981, Murie 1981, Gebhard 1982, Hechtel 1985, Phillips 1985).

The frequent contact required for formation and maintenance of a dominance hierarchy is not typically found in widely dispersed backcountry populations (Pearson 1975). However, some of the age/sex class relationships, expressed at the high density areas (McNeil Falls and Yellowstone dumps) were also observed in the context of chance encounters or moderate seasonal aggregations of normally dispersed populations.

Grizzly bear concentrations at early spring foraging areas, fall berry crops or other seasonal attractants were documented in a number of areas. For example, Atwell et al. (1980) reported that grizzlies congregated (up to 2.6 bears per km^2 at midsummer alpine foraging areas on Kodiak Island. Singer (1978) studied the spring and fall grizzly bear concentrations along the North Fork of the Flathead River, along the western border of Glacier National Park. Martinka (1974a, 1974c) reported that in Glacier National Park, grizzlies concentrated in lowland meadows and snowslides in spring, subalpine areas in summer and spawning streams in fall. He observed distinct spacing among individuals and social units at these concentrations. Pearson (1975) reported that all bears except family groups congregated along valley floors as berries ripened in the fall. He felt that avoidance reactions tended to minimize confrontations. Murie (1981) reported that grizzly bears in Denali National Park sometimes concentrated at choice feeding areas. He found that most chance encounters between grizzly bears were followed by a quick appraisal and possibly a brief chase.

As at salmon streams and garbage dumps, observation of encounters in backcountry populations suggested that adult males occupied a dominant position and young bears held a low position in the social hierarchy. A few representative encounters are described below. Incidents involving intraspecific killing by adult males and the influence of adult male density on reproduction and recruitment rates are discussed in subsequent sections.

Peacock (1978) noted that in the Apgar Mountains, large solitary adults influenced the distribution and dispersal of the fall berry-feeding congregation. Family groups and smaller adults avoided the particular drainages where lone adults foraged. Murie (1981) described several cases where adult males intimidated family groups or young bears in Denali National Park. Younger bears appeared very apprehensive and almost always retreated when near other bears. Mattson et al. (in pressb) reported that relocation data from the Yellowstone ecosystem suggested that subadult grizzlies were displaced away from secure backcountry areas and toward human emplacements (roads and developments) by more dominant bears. Mundy and Flook (1973) reported that in Glacier National Park 2 subadult bears consistently retreated when a certain large adult approached. Phillips (1986) observed a mature male pursuing a 5-year-old male which walked and ran from the larger bear for 1 hour.

Magoun (1976) reported that a female and cub abandoned a caribou carcass when an adult male approached. Similarly, Craighead and Craighead (1971) reported that a male elicited submissive behavior from a female and yearling at a backcountry bison carcass. Conversely, Barnes and Bray (1967) reported that a sow with 2 yearlings observed at a backcountry bait station was often tolerant of other bears but was consistently dominant in aggressive interactions.

Several studies revealed spatial segregation by age and sex class. Family groups appeared to seek isolation from other bears, particularly adult males. Peacock (1978) noted that in the Apgar Mountains, large, solitary, adults influenced the distribution and dispersal of the fall berry-feeding congregation. Family groups and smaller adults avoided the particular drainages where lone adults foraged. Similarly, Pearson (1975) reported that in the Yukon, females with young of the year avoided the fall berry-feeding concentrations along the valley bottoms. Gebhard (1982) and Stelmock (1981) found that during the breeding season, family groups avoided contact with other bears. In Yellowstone, females with cubs of the year appeared to select secure but less productive habitat during the spring to provide security for the cubs (Knight et al. 1986). In the northern Yukon, adult females with, and without, young were found most often at elevations less frequented by adult males (Nagy et al. 1983a). On the Alaskan Peninsula, females with newborn cubs were captured infrequently in the spring because they tended to remain in mountainous terrain in protective cover (Glenn and Miller 1980). Russell et al. (1979) found that in Jasper National Park, females with young and independent subadults actively avoided adult males. Adult males tended to frequent valley bottoms or lower slopes while females and subadults spent a disproportionately greater time on upper slopes and side basins with readily available escape routes. Movement patterns of family groups and weaned subadults also suggested avoidance of other bears.

Wielgus (1986) reported that in the Kananakis country of southern Alberta, grizzly bear habitat use segregation suggested a dominance hierarchy similar to the 1 described at McNeil Falls (Egbert and Stokes 1976). Adult males were dominant and excluded other bears from the most productive foraging areas (ungulate prey and rich berry-feeding areas). Females with cubs were subordinate only to adult males which they actively avoided. Lone females and subadults had lower social standings.

Threat Behavior

Social species have evolved complex communication repertoires to minimize aggression by the substitution of ritualized behavior for actual fighting. Bears, being solitary carnivores, lack the wide assortment of visual signals found in some social species (Egbert and Stokes 1976). The short ears, short tail and long fur of bears prevent the grizzly from using these parts for signals as effectively as some other mammals. Instead, body orientation and movements are the primary means of conveying information to rivals (Stonorov and Stokes 1972).

Certain behavior patterns are characteristically associated with dominance or submission. Mouth, head, ear and body positions have important signal value. Lateral body orientation, looking away and retreating generally connote submission while frontal body orientation, a direct gaze and forward locomotion connote aggression or dominance (Stonorov and Stokes 1972, Egbert and Stokes 1976, Egbert 1978, Colmenares and Rivero 1983b).

Stonorov and Stokes (1972) recorded individual behavioral components seen during encounters at McNeil Falls to determine how threat or appeasement signals were used to reduce physical contact. Individual behaviors were placed into 6 broad groupings: locomotion, body orientation, head orientation, mouth position, ear position and contact. Each behavior was analyzed according to the number of times it was associated with dominant or subordinate interactions. Components which were associated largely with dominance were frontal orientation, approach, showing of canines, muzzle twist and neck stretch. Components which were shown largely by subordinates were lateral orientation, turning away and dropping of the head and sitting or lying down. Laid-back ears were associated equally with dominant and subordinate interactions. The nature of agonistic encounters changed during the course of the fishing season. Dominant animals shifted to less intensive threat; the frequency of charges fell sharply as the number of deferrals rose correspondingly. The work of Egbert and Stokes (1976) corroborated those findings; the frequency of fleeing and chasing declined rapidly during the first 10 days of the fishing season while tolerances to the proximity of other bears and number of reciprocal threats increased.

A later study at McNeil Falls (Egbert and Stokes 1976) identified generalized forms of brown bear interactions: head-low threat (low intensity), head-high threat (high intensity), charges, contact or fighting, approach — avoidance, amicable (non-agonistic) behavior and play. The head-low threat (head held below horizontal line of the body) involved various body orientations and typically occurred when bears were separated by less than 4 m. Stonorov and Stokes (1972) described a similar low intensity threat, "jawing," which typically occurred between bears of comparable status, especially females. The head-high threat (head held diagonally upward) occurred at close range and was usually associated with a frontal body orientation. As in Stonorov and Stokes' (1972) study, ear position was variable. Ears were usually laid-back during the head-low threat and final stages of a direct charge but were erect during the initial stages of a direct charge and during some stages of avoidance reactions.

Egbert (1978) described the nuances of bear facial expressions and vocalizations associated with agonistic encounters. He found that vocalizations were the least ambiguous signals in the brown bear's communication repertoire. The 5 major types of vocalizations and the context within which they most frequently occurred were: huffing (tension), woofing (startled), growling (intolerance), roaring (conflict) and bawling (seeking contact).

Colmenares and Rivero (1983a, 1983b) performed a temporal analysis of brown bear behavior patterns to determine what behaviors or groups of behaviors were most closely associated with aggression. Of particular interest was the appearance of certain "maintenance activities" (rubbing, clawing, biting and scratching) in the context of aggressive encounters. Individual behaviors were grouped into 9 "clusters" according to temporal association and function. One such cluster consisted of various behaviors, such as clawing or biting of objects, rubbing and urination, which occurred in conflict situations and resulted in the deposition of scent marks on particular objects. Behaviors indicative of avoidance or fear included huffing, looking away, fearful growl, sitting, teeth clacking and retreat. Detailed descriptions of these behaviors were not provided.

J. Craighead (panel discussion, Int. Conf. Bear Res. and Manage. 2:245) described the aggressive behavior of grizzly bears at the Yellowstone dumps. Threatening males generally approached other males with a stiff legged walk. The second bear turned its head to one side and backed up if it wished to avoid an encounter. A stiff-legged gait was associated with dominant behavior in other studies also (Stonorov and Stokes 1972, Pearson 1975). Facing away and backing up were always associated with submission at McNeil Falls (Stonorov and Stokes 1972). Erickson (1965) reported that when a sow with cubs threatened a large male, the male typically turned its shoulder toward the female. Stonorov and Stokes (1972) also found that a "lateral orientation" was generally associated with submission.

Several types of charges were described in the literature (Egbert and Stokes 1976, Egbert 1978). "Direct" charges were hard, fast rushes at the opponent with head held slightly below normal, gaze fixed on the opponent, and ears erect initially but laid back as it closed or when the receiving bear fled. A direct charge was usually accompanied by a growl which developed into a roar. "Short" charges were similar to direct charges but ended after a few strides and sometimes bluffing. These rushes ended when the receiving bear either fled or stood its ground (Egbert and Stokes 1976, Egbert 1978).

A third type of charge, described at McNeil Falls, seemed to involve a combination of threat and avoidance and was seen only during the early days of the fishing season. It was characterized by a stiff, exaggerated rocking gait with the head held erect and the ears cocked forward. Jope (1982, 1985) observed a similar charge, the "hop-charge" directed toward hikers in Glacier National Park. In the hop-charge, the grizzly advanced with a rapid, stiff-legged, hopping gait moving both legs together and holding the head erect. These charges were terminated after only a few paces.

Breeding Season Conflict and Scarring

Several studies have shown an increase in intraspecific conflict during the breeding season (e.g., Hornocker 1962, Mundy and Flook 1973, Pearson 1975, Egbert and Stokes 1976). J. Craighead (panel discussion, Int. Conf. Bear Res. and Manage. 2:245) reported that breeding season conflicts resulted in severe injuries but no mortalities. Schleyer (1983) found evidence of a violent confrontation between 2 adult males during the breeding season in Yellowstone. Since no carcass or other food source was found in the area, he attributed the fight to a breakdown of the usual avoidance reaction during the breeding season. Mundy and Flook (1973) described 2 cases in which adult males fought during the breeding season while females were nearby. Magoun (1976) observed a mated pair appropriate a caribou carcass from a younger male. The male of the mated pair confronted and expelled the smaller male from the

area before feeding on the carcass. Russell (1967) described 2 incidences of breeding season combat, 1 in Jasper National Park and the other in Denali National Park. Egbert and Stokes (1976) reported that males were particularly "irascible," especially toward other males, when consorting with, or trailing, an estrous female. Pearson (1975) reported that in the southern Yukon, most large males captured during the breeding season had fresh wounds. He felt that competition for sows in estrous resulted in the breakdown of the avoidance reaction and an increase in physical contact. He also observed that the presence of an estrous female increased a male's "zone of intolerance" and the violation of this zone by another male provoked aggression.

Several researchers reported that adult male grizzlies often bore scars or wounds. Hornocker (1962) reported that in Yellowstone, some adult males had massive wounds and scars on the head and neck when captured. Ears were often mutilated or torn off on older males and many had torn and scarred lips and jaws. Egbert and Stokes (1976) reported that at McNeil River Falls, most adult males bore scars and battered ears. Wielgus (1986) found that in the Highwood Valley of southern Canada all adult males had many combat scars on the head, neck and shoulders. Some subadults also bore scars but no females had scarring. In the central Brooks Range, only 2 of 23 captured grizzlies had evident wounds or scars. One of these was thoroughly mauled and the other was missing the pinna and front of the lower lip (Crook 1971).

Intraspecific Aggression, Mortality and Cannibalism

Cases of Predation on Cubs, Young Bears and Families by Adult Males or Unknown Adults

Most cases of intraspecific mortality described in the literature involved cubs or young bears killed, or presumed to be killed, by adult males. Instances of overt aggression, without actual killing, by adult males towards young bears or family groups are also discussed herein.

Troyer and Hensel (1962) described 3 cases in which cubs were apparently killed by adult bears during May and June on Kodiak Island. In 2 of these cases, adult males consumed at least part of the carcass. On Admiralty Island, Schoen and Beier (1986) reported that 1 litter with 2 cubs of the year was presumed killed by a male in early summer. On the Alaskan Peninsula, Rausch (1958) found the remains of a cub which was apparently eaten by an adult and, on another occasion, witnessed a large bear pursuing a cub of the year. Both incidents occurred in August. Also on the Alaska Peninsula, Miller (panel discussion, Int. Conf. Bear Res. and Manage. 2:254) observed a large bear eating a cub; an agitated female with another cub was nearby. This case was also described by Glenn (1971:7).

At McNeil River Falls, researchers found the fresh, partially consumed remains of a 2½-year-old subadult which had been killed by another bear. At the time, 4 large males and 5 estrous females were present at the falls (Egbert and Stokes 1976). However, Egbert (1978) reported that only 1 adult male at McNeil River Falls ever demonstrated an interest in a cub and, in that case, the male apparently only wanted to smell it. Glenn et al. (1976) reported finding 1 dead cub at McNeil River Falls with a large neck wound apparently inflicted by another bear (possibly the same bear that killed the 2½-year-old noted above). They also described 2 cases in which single cubs out of triplet litters became separated from their mother and were not seen again.

Ballard et al. (1982b) observed a female with a single surviving cub from a litter of 3 fleeing from a lone adult bear. They believed that predation by adult males may have been responsible for a marked difference in litter size between cub and yearling litters. Miller and Ballard (1982b) suggested that the offspring of translocated females suffered high mortality rates due to increased vulnerability to predation by resident adult males.

Several researchers reported cases of intraspecific aggression or mortality in Denali National Park, Alaska. Russell (1967) described an incident in Denali in which a 3-year-old male approached a mating pair and was subsequently killed by the mature male. Stelmock (1981) observed what may have been a lone male pursuing a female with 2 2-year-old young. The chase, which lasted about 1 hour, was apparently directed toward the female rather than her offspring. Dean et al. (1985) described 2 cases of adult males pursuing family groups in late May and early June. In the first case, a female was killed and her yearling was critically injured. In the second, the male killed a yearling and fed on its carcass. Murie (1981) reported that a 4-year-old grizzly (sex undetermined) was killed and partially eaten by a larger bear in late July near the Denali garbage dump. On another occasion, also in July, a large male grizzly was observed pursuing a sow and yearling. The chase was suspended after the male was apparently alarmed by nearby hikers (Murie 1981).

In the eastern Brooks Range, a large bear was observed feeding on a sow and yearling at the mouth of a den. It was not evident if the 2 bears had died in the winter or were killed by the larger bear (Reynolds 1976). Reynolds and Hechtel (1980) reported that in the western Brooks Range, a single large adult male killed at least 2 young grizzlies (a 2-year-old male and a cub) and may have also killed an adult female and her 2 2-year-old offspring. In the latter case, the female was found dead about 1 mile from her den with wounds inflicted by a much larger, presumably male, grizzly. The young bears were not observed again and were suspected mortalities. On another occasion, a large male was observed stalking and confronting a female with 3 young. A later report from the same study area (Reynolds and Hechtel 1984b) documented another case of an adult male killing a cub. A large adult male was observed feeding on a cub and presumably also killed its missing littermate. The family group had been observed intact the previous day. Also in the Western Brooks Range, Gebhard (1982) observed a large male chasing a sow with 2 cubs for over 4 km.

Nagy et al. (1983b) documented 3 cases in the Tuktoyaktuk Peninsula/Richards Island region of northern Canada in which entire litters were lost in the spring. These losses were tentatively attributed to predation by adult males. Nagy and Russell (1978) reported that in the Swan Hills region of Alberta a yearling male "succumbed to natural predation" in late July. Specifics of the case were not provided although "natural predation" would seemingly refer to predation by another grizzly. In Jasper National Park, 1 of 3 orphaned grizzly bears which survived a winter and spring on their own disappeared in late July. Evidence

suggested that an adult male probably killed the yearling orphan (Russell et al. 1978). Herrero (1985) reported that a large grizzly bear severely mauled and killed a smaller (68 kg) male during the end of the breeding season in Jasper. In the southwestern Yukon, a young (4.5-year-old) male was killed after a violent struggle with another bear (Pearson 1975). This encounter occurred during the period when bears congregated in the alluvial floodplains to feed on berries and roots. Pearson noted that this aggregation was accompanied by a recurrence in agonistic encounters but most skirmishes were usually of short duration and ended when 1 bear retreated. The outcome of this encounter may have been influenced by the recent capture and drugging of the young male.

Craighead et al. (1976a) documented 8 records of infanticide in Yellowstone National Park. Details of these mortalities were not provided. Craighead (panel discussion, Int. Conf. Bear Res. and Manage. 2:245) reported that he had found some yearlings killed or severely mauled in Yellowstone. He also noted that cubs were usually killed by large males in the spring and these mortalities were not restricted to the dump areas. McCullough (1981) reported that National Park Service personnel found 3 cubs killed in one night at the Rabbit Creek dump. Knight et al. (1986) reported that grizzly cub remains were sometimes found in scats in Yellowstone. Roop (1980a) reported that a yearling female which sustained an ankle injury in a snare east of Yellowstone National Park was killed a few days after release (in May) by a large bear.

Cases of Predation on Older Bears by Adult Males

Pearson (1972) reported that in the southwestern Yukon, an old male (20+ years) was killed by other bears. Pearson (1975) described a case in which an adult male apparently dug a mature female out of an exposed den and killed her. He interpreted this as possible evidence of intense competition for den sites on a preferred slope. Nagy et al. (1983a) reported that in late September, a 6-year-old, 152 kg male, was killed by a 9-year-old 273 kg male in their northern Yukon study area. Much of the carcass was consumed (also described by Pearson 1976b).

Reynolds (1974) reported that in the eastern Brooks Range, an adult male killed an adult female in late September. The female died as a result of a broken neck and massive wounds along the top of the hump. The carcass was not consumed but the male had bitten the genitalia several times. Tracks in the snow suggested that the male had deliberately shifted his direction of travel to approach the female when he was about 23 m away.

Murie (1981) reported that an old female (mother of 3 cubs) was killed in late August near the Denali National Park garbage dump. Murie speculated that she may have been attacked by a large male while she was trying to protect her cubs.

Intraspecific Aggression and Killing by Adult Females

Intraspecific killing by adult female grizzlies has been documented in the literature less frequently than predation by males. Some of the cases described in the preceding section in which the identity of the aggressor was undetermined may actually have involved adult females.

Murie (1981) described an encounter in Denali National Park in which a female (with 2 cubs) pursued another family group and killed 2 cubs. The 2 family groups had occupied the same summer range in relative harmony but on this occasion, 1 cub apparently strayed too near the other family group and provoked a charge.

In southcentral Alaska, Miller (1985b) observed a lone female chasing another female with 3 yearlings. The pursuing female was accompanied by an adult male. On Kodiak Island, Troyer and Hensel (1962) reported that a female with at least 1 yearling killed and fed upon a female bear which was caught in a snare. At Pack Creek, in southeastern Alaska, a young female grizzly (with 1 cub) attacked and killed an adult male which ventured too near. In this case, the female also suffered mortal wounds (Herrero 1985).

Schoen and Beier (1986) described 1 instance of maternal cannibalism on Admiralty Island. Two cubs apparently died during the winter and were consumed by their mother. Although this was not a confirmed case of maternal infanticide, other researchers (Knight et al. 1986) reasoned that infanticide could allow a sow to terminate an energy deficit state (from lactation) and also recycle energy already invested in cub production.

Theoretical Considerations of Intraspecific Killing

Adult bears can increase their fitness through "prudent cannibalism" (Rogers 1978, Bunnell and Tait 1981, McCullough 1981). Bunnell and Tait (1981) noted that an adult male's reproductive fitness was critically dependent upon changes in the relative density of adult males to adult females. Consequently, anything an adult male did to reduce the number of competing adult males could enhance his own fitness. This is manifested by aggression toward younger males (killing and forced dispersal).

Reynolds and Hechtel (1984b) discussed the sociobiological implications of infanticide. They noted that females which lost their cubs from early May to late June were often available for breeding soon thereafter. Nagy et al. (1983b) reported that 2 females bred soon after losing their cubs. Thus, dominant males can increase their individual reproductive fitness by killing cubs of females they have not copulated with and thereby induce a female to come into estrous sooner than if the cubs were reared (McCullough 1981).

Other benefits derived from killing genetically unrelated bears as related to food value of the carcass and reduced competition for food, mates and space. Costs, including energy expenditure and potential injury, are minimized by killing small or vulnerable bears (Rogers 1978).

Non-Agonistic Encounters and Unusual Groupings

Egbert and Stokes (1976) observed 2 types of non-agonistic encounters at McNeil River Falls. "Amicable" encounters referred to brief encounters in which bears lightly contacted each other in the head and neck regions. More prolonged interactions involving mock fighting or sexual mounting were defined as "play." Almost all of the observed non-agonistic encounters involved adolescent or subadult bears. The frequency of these encounters varied according to the within-year and between-year abundance

of salmon with the greatest number of encounters when salmon were most plentiful.

Reports of unusual groupings of grizzlies or seemingly amicable encounters are also available for other study areas. Most unusual associations appeared to result from breeding or maternal behavior. A few of these cases are mentioned below.

Peacock (1978) observed a female with 2 yearlings accompanied by a medium-sized adult and, on another occasion, a female and 1 yearling accompanied by an adult (at 50-150 m). Both groupings were observed during the late summer berry-feeding concentrations in the Apgar Mountains of Glacier National Park. Martinka (1974) reported 4 unusual associations among grizzly bears. In one case, an adult male was observed with a family group shortly before dissolution of the maternal bond and breeding took place. In the other 3 cases, females with young tolerated the presence of subadults or young adults for brief periods. Murie (1981), Stelmock (1981) and Gebhard (1982) also found that females with young sometimes tolerated the presence of nearby young bears for brief periods.

Colmenares and Rivero (1983b) documented an exceptional case of group cohesion among 6 captive brown bears. They found that a social hierarchy was present, however, unlike the situation in wild populations (Hornocker 1962, Egbert and Stokes 1976), the main factor in attaining a high social rank was each male's ability to achieve an alliance against other bears. Young bears played together and developed cohesive social bonds with companions. These affiliations were apparent in cooperative attacks on rival bears. Hornocker (1962) mentioned 1 incident in which 2 "aggressive females" simultaneously attacked the dominant male at the Trout Creek dump. Craighead and Craighead (1972c) reported that 2 or more grizzlies sometimes pursued and killed elk in well-coordinated attacks. They did not state if these observations referred to family groups.

Certainly the most common form of non-agonistic or amicable behavior described in the grizzly bear literature was sibling play behavior. Good descriptions of sibling play are provided in Troyer and Hensel (1969), Murie (1981) and Gebhard (1982).

Territoriality

A territory, by strict definition, refers to a "specific area from which an animal excludes all others of its species except mates and its own offspring (usually of that year)... (Craighead 1979:142)."

Bears are socially flexible in their use of space (Herrero 1978b, Cowan: panel discussion, Int. Conf. Bear Res. and Manage. 2:250). The system of spacing varies according to the relative evenness or concentration of food and the defendable nature of the food source (Herrero 1978b). Bunnell and Tait (1981) noted that, in theory, where resources were plentiful and evenly distributed or accessible and predictable, territoriality would be the optimal spacing mechanism. Conversely, territorial defense of ranges with patchy or unpredictable food resources would not be advantageous.

Grizzly bear home ranges are often so large and disjunct that territorial defense is infeasible (Jope 1982). Many studies of grizzly bear home ranges and movement patterns have found substantial home range overlap (e.g., Lloyd 1979, Ballard et al. 1982b, Craighead and Mitchell 1982, Nagy et al. 1983b, Servheen 1983). In Yellowstone (1959-1970), grizzlies did not defend the peripheries of seasonal or home ranges (Craighead 1976, 1979). Grizzly bears also did not defend den sites. Craighead and Craighead (1973) reported that 2 sows with cubs which travelled together throughout the summer and fall were together at 1 sow's freshly dug den with no indication of aggressive behavior by either grizzly. Feeding sites were sometimes temporarily defended. On 1 occasion, a male grizzly was observed to defend a bison carcass from a sow and yearling. The incident could be interpreted as either territorial defense of an extensive area surrounding a temporary food source or as submissive behavior by the sow (Craighead and Craighead 1971, Craighead 1979). Hierarchical behavior and territorial defense merge and may be difficult to distinguish in certain aggressive interactions (Craighead 1979).

In the southeastern Yukon, adult females maintained home ranges with minimal overlap, however, Pearson (1975) felt that intraspecific aggression in defense of a home range was not the mechanism that maintained this spacing. Rather, the distinct ranges related to attachment to, or preference of, a familiar area. Although intraspecific aggression in defense of a home range was not apparent, Pearson felt that an intraspecific intolerance zone did exist around each individual. The size of this zone varied with season and situation. For example, the zone was enlarged when males consorted with estrous females.

"Violation of individual distance" was 1 of 4 situations which precipitated aggression at McNeil River Falls (Stonorov and Stokes 1972). The establishment and maintenance of dominance hierarchies at feeding aggregations results in the temporary breakdown of the usual avoidance reaction (Pearson 1975) and enables maximum exploitation of rich food sources with a minimum of conflict (Bunnell and Tait 1981, Craighead and Mitchell 1982). Where a social hierarchy is formed, it may serve as a substitute for territorial behavior and territorial defense (Craighead 1979; panel discussion, Int. Conf. Bear Res. and Manage. 2:250).

Marking Behavior

Two major kinds of marking behavior by brown/grizzly bears were discussed in the literature: marking trees (e.g., Shaffer 1971, Valkenburg 1976, Smith 1978, Lloyd 1979, Hamer et al. 1980, Murie 1981, Hamilton and Archibald 1984) and ground (step or trail) marking (e.g., Valkenburg 1976, Smith 1978, Lloyd 1979, Murie 1981, Hamilton and Archibald 1984).

Marking Trees

Bear trees are generally located adjacent to bear travel routes. Physical evidence of bear use may include stripped or smoothed bark, tooth marks, broken or bent branches (up to a height of 3-5 m), and hairs lodged in cracks or pitch (Shaffer 1971, Lloyd, et al. 1977, Smith 1978, Lloyd 1979, Hamer et al. 1980, Murie 1981). Lloyd (1979) noted that physical evidence might not always be apparent for those bear trees used exclusively for rubbing.

Lloyd (1979) found that bear trees were widespread and common in his coastal British Columbia study area. The density of bear trees was 3.4/linear km of major watercourse or 20 per sq km. During the salmon run, trees were

marked as often as once every 5 days. Lloyd (1979) concluded that the high incidence of marking behavior served to reduce intra- and interspecific strife by warning other bears of the presence of nearby fishing or resting bears. He felt that the unpredictable wind currents and high level of background noise along watercourses interferred with the usual olfactory clues. A later study in coastal British Columbia also documented a relatively high incidence of marking trees and trails (Hamilton and Archibald 1984). Two types of trees were identified: "scratch" trees with claw marks or, sometimes, tooth marks, and "rub" trees with little or no scratching of the bark.

Various hypotheses have been proferred to explain the function of bear trees. It has been suggested that they serve as information signposts, territorial markings, declaration of ownership, sexual advertisement (during the breeding season) or for grooming and comfort purposes (Hamer et al. 1980, Murie 1981, Hickman 1984). Murie (1981) concluded that although bear trees might serve to communicate the passage of an estrous female during the breeding season, their primary function was for massaging. Craighead (panel discussion, Int. Conf. Bear Res. and Manage. 2:248) also felt that tree rubbing was most common soon after emergence and probably served for grooming or comfort.

Studies with captive brown bears have suggested that the massaging function may be intergrated with the scent-marking function. Colmenares and Rivero (1983a) found that "rubbing against objects" was one of 5 behaviors which appeared in conflict situations and whose performance resulted in the deposition of scent marks on particular objects. Tschanz et al. (1970) studied the rubbing behavior of captive brown bears and concluded that scents emanating from rubbing places, urine and feces did have a social communication function. In males, maximum rubbing occurred during May (breeding season) while in females it occurred in July (end of the molt). Males demonstrated the strongest response to rubbing places and were able, by sniffing, to determine the sex of the previous individual to rub at that site. Young bears withdrew from a frequently used male rubbing tree when first introduced to the enclosure.

Reiger (1972) discussed the origins, types and significance of scent-rubbing behavior in various carnivore groups. "Scent-rubbing" referred to rubbing or rolling on an environmental object, usually an odorous scent-source, to transfer scent from the environment onto the animal's body. He reported (based primarily on earlier studies of European brown bears) that brown bears were induced to rub by urine, previous scent marks and certain chemicals. Some bears rolled in fresh urine before tree-rubbing. Possible functions of scent-rubbing included vestigal behavior of scent-gland rubbing (for glands lost during evolution), comfort behavior, camouflage of odors for predation and increased social attractiveness.

Ground Marking

Grizzly bear ground marking was also described in the literature. Murie (1981) reported that in Denali National Park, he sometimes found short stretches of trail where grizzly bears stepped in the same tracks over a period of years eventually creating a series of depressions. The depressions were about 2.5 cm deep, 25 cm wide and 30 cm long and were separated by a distance of 58-76 cm where the front and hindfeet stepped in the same spot. Murie also observed grizzly bears crossing snowbanks in a similar fashion, precisely placing their feet in previous imprints.

Lloyd (1979) found very similar impressions in his coastal British Columbia study area. Five to 16 elliptical depressions (about 18-25 cm by 15 cm) were generally found in a single series. The surface vegetation was removed and no sign of a track or claw marks was visible. Lloyd (1979) concluded that these ground marks were deliberately formed and functioned as visual and possibly tactile communication. Smith (1978), also in coastal British Columbia, found 6 instances of ground marks in sandy substrate. The marks were in a typical stride sequence but, in at least 1 case, were 4 times deeper than the usual foot imprint. Some ground marks were near marking trees. Hamer et al. (1980) reported that they sometimes found a series of stepping places several centimeters deep leading to bear trees in Banff National Park.

COURTSHIP AND COPULATION

Breeding Season Chronology

The breeding season may be defined as either the period when copulations are observed or as the more inclusive period when males and females are observed consorting together or displaying pre- and post-copulatory behavior (in addition to actual mating). Most studies expressed breeding season dates according to the latter criteria. Representative breeding season dates from major grizzly/brown bear studies are given in Table 7.

The most extensive data on grizzly bear reproductive behavior comes from the Craighead study in Yellowstone National Park (Craighead et al. 1969, Craighead and Mitchell 1982). They found that although the start of the breeding season (copulatory period) varied from 26 May to 12 June during a 6-year period, the length of the season proved remarkably similar, averaging 26 days per season. Over all years, 80% of the observed copulations were in June (particularly during the first 2 weeks), 12% were in late May and 8% were in July.

Estrous Duration and Reproductive Physiology

In Yellowstone, the maximum duration of estrous for an individual female was 27 days, with a range for other females of 25 to 16 days and less. Females in estrous were identified by their attraction and receptivity to adult males and by marked enlargement of the vulva. Conspicuous vulva swelling on estrous females was also noted by other researchers (Troyer et al. 1969, Pearson 1975, Glenn et al. mm in diameter before the breeding season in comparison to 6, Nagy et al. 1983a, 1983b). Estrous generally ended abruptly and pre- and post-estrous females did not attract any males (Craighead et al. 1969, Craighead and Mitchell 1982).

Observations in Yellowstone also suggested that female grizzlies had 2 estrous cycles or "mating periods" of 10 6-12 mm during the breeding season. Three females harvested while aximum (identified by attraction of mates, paired

Table 7. Dates of breeding season (courtship associations) for North American grizzly bear populations.

Ecosystem, Area and Citation	Breeding Season	Comments
Yellowstone Ecosystem		
(J. Craighead et al. 1969, J. Craighead and Mitchell 1982)	May 14-Jul 15	period of estrous behavior (including pre and post-copulatory behavior)
	May 26-Jul 9	copulations observed (80% in June, especially first 2 weeks)
Trout Creek dump (Hornocker 1962)	Jun 10-Jul 10	copulations observed; peak in late June
Northern Continental Divide Ecosystem		
Rocky Mountain East Front (Aune 1985, Aune and Stivers 1983,1985, Aune et al. 1984, 1986)	Apr 21-Jun 28	earliest and latest courtship associations
Canadian Rockies		
Jasper Natl. Park (Russell et al. 1979)	mid-May-early July	probably courtship dates for Banff/Jasper area
Banff Natl. Park (Hamer et al. 1978,1979,1980, Herrero and Hamer 1977)	May 13-Jun 21	courtship associations observed
Interior British Columbia		
Glacier Natl. Park (Mundy and Flook 1973)	Apr 30-Jun 25	observations of 21 adult pairs
Coastal British Columbia		
Kimsquit River Valley (Hamilton and Archibald 1984)	May 19-Jun 21	breeding activity
Northern Interior		
S.W. Yukon: Kluane Natl. Park (Pearson 1975)	May 21-Jul 16	courtship associations; peak in June and early July
Canadian Arctic		
Northern Yukon (Nagy et al. 1983a)	May 5-Jul 15	courtship associations
NWT: Tuktoyaktuk Peninsula/ Richards Island (Nagy et al. 1983b)	May 21-Jul 23	courtship associations
Arctic Alaska		
Eastern Brooks Range (Reynolds 1974)	May 26-Jul 9	breeding pairs
Canning River (Quimby and Snarski 1974)	June 2-30	paired adults observed
Arctic Natl. Wildlife Refuge (Phillips 1986)	Jun 13-Jul 8	observed 5 breeding units
Interior Alaska		
Denali Natl. Park (Dean 1976)	May 30-Jul 17	observations of mated pairs
(Stelmock 1981)	May 14-Jul 4	consorting bears; also documents one Aug 12 date from previous year
(Murie 1981)	May 14-Jul 10	breeding pairs; peak in last week of May and in June
Southcentral Alaska		
Upper Susitna (Ballard et al. 1982)	late May (in progress)-end of June	breeding pairs
Copper River Delta (Campbell 1985)	May 14-Jun 18	observed pairs

Table 7. (Continued)

Ecosystem, Area and Citation	Breeding Season	Comments
Alaska Peninsula		
Black Lake area (Modafferi 1984)	early May-early August	breeding pairs and copulation
Kodiak/Afognak		
Kodiak Island and Alaskan Peninsula (Hensel et al. 1969)	May through mid-July	as evidenced by studies of reproductive tracts and observations of matings

with tivity and copulation) separated by a 4-18 day period of non-estrous behavior. The intervening period may have corresponded to the time required for follicular males during ment which followed the first ovulation (Craighead et al. 1969, Craighead and Mitchell 1982). Nagy et al. the last half ptured 3 mated or estrous females in May which of May subsequently observed consorting with males in late June or early July. Observations suggested that these had ovaries may have cycled more than once in a single mating season or remained in constant estrous between observations.

Hensel et al. (1969) studied the reproductive physiology of female brown bears from examination of 96 reproductive tracts. They found that follicular development apparently began during torpor. Mature females had follicles from 1-5 with follicles 10-12 mm in diameter. Counts of corpora lutea in 10 pairs of ovaries indicated a mean of 2.1 ovulations. Ovaries from prepubertal bears weighed half as much as those from mature animals and showed no gross morphological differences during the breeding season. Pearson (1975) reported that 3 females killed during the breeding season had either large developing follicles on the ovarian surface or recently formed corpora lutea. Mature females harvested from August 14 through October 21 which showed reproductive activity during that period all had corpora lutea and unimplanted blastocysts in the uteri.

Erickson et al. (1968) examined the testes, epididymides and vasa deferentia of 127 brown bears collected in Alaska. Their histological studies indicated that the male bear's reproductive period extended prior to and beyond the female's breeding season. Some individual males were sexually capable well before the peak breeding season while others were still able to breed until near denning in November. Thus, the male bear had a potential breeding season slightly exceeding half of the year and encompassing most of the den-free period. Practically all mature males produced sperm during the period of normal female breeding activity (late May to early July).

Pearson (1975) also examined the reproductive tracts of male grizzlies. Presence or absence of spermatozoa and condition of the seminiferous tubules indicated the male's reproductive status. An animal collected on May 22 was the first to show spermatozoa in the epididymis. Testes collected on 3 September showed characteristics of a post-breeding state and those from 22 September were in a resting state. Mundy and Flook (1973) reported that a testicular section from a bear captured on June 1 showed maturing seminiferous tubules with a few spermia present.

Courtship Behavior, Activities and Habitat Use

Descriptions of courtship behavior in the literature varies greatly. General characteristics of courtship activity are described below.

Several researchers noted that sexually aroused males could be recognized by their walk or by other behaviors. Murie (1981) reported that some males deliberately searched for females during the breeding season. These males travelled steadily and appeared to be trying to locate the scent trail of estrous females. Hornocker (1962) reported that aroused males were characterized by their stiff-legged, swaggering walk with bowed neck and head held low. These males also salivated profusely and urinated on their belly and legs. Schleyer (1983) noted that a mated male assumed a similar walk and head position without the urination or salivation. Lindermann (1974) observed a strange, swinging gait in a male approaching an estrous female. Egbert (1978) reported that males approached estrous females with a slow, deliberate walk with their ears cocked and with the head held higher than normal.

Murie (1981) reported that in Denali, males of mated pairs frequently behaved as though "herding" females by directing their movements and intercepting their attempted departures. Herrero and Hamer (1977) observed a prolonged incidence of herding behavior in Banff National Park. In this case, a male kept a female confined within a 2-3 ha "mating area" for 13 days. Mounting and copulation occurred only during the final stages of the confinement and the herding behavior subsided immediately thereafter. Additional observations of herding behavior were described by Hamer et al. (1978, 1979) for Banff National Park and by Stelmock (1981) for Denali National Park.

Mated pairs often engage in various forms of nonaggressive physical contact including playful behavior, nuzzling, licking and genital inspection (Hornocker 1962, Lindermann 1974, Herrero and Hamer 1977, Egbert 1978, Murie 1981, Stelmock 1981, Schleyer 1983, Phillips 1986). Several observers noted that females controlled the occurrence of this nonaggressive physical contact and the course of the courtship activity (e.g., Herrero and Hamer 1977, Egbert 1978, Murie 1981).

As Herrero and Hamer (1977) observed, pairing during courtship is a fragile bond which could easily revert to aggression. The mating bond is a tenuous, short-term arrangement for the convenience of breeding or sometimes a partnership that persists throughout the estrous period

(Craighead et al. 1966, Craighead and Mitchell 1982). Several observers noted that brief episodes of aggression sometimes occurred between mated pairs (e.g., Herrero and Hamer 1977, Murie 1981, Schleyer 1983). Egbert (1978) noted that female bears at McNeil River never appeared to fully shed their fear of adult males and frequently walked or ran from adult males. Hornocker (1962) reported that although estrous females were receptive to all males, they invariably cowered and assumed a submissive attitude at the approach of an aroused male.

Phillips (1986) recorded the activity patterns of 5 breeding bear units (2 groups included 3 bears) in the Arctic National Wildlife Refuge. He found that breeding units spent 67% of the observation time resting; rest periods were longer and more frequent than for lone bears. Similarly, Hechtel (1985) found that a female, accompanied by 2 3-year-olds prior to pairing with a male during the breeding season, was significantly less active during the breeding period (21% of the observation time) than while still with her young (56-74%). Stelmock (1981) reported that during the spring, mated pairs were somewhat less active during the day than other bear units.

Hechtel (1985) reported that the percent of time spent feeding dropped dramatically (from 60% to less than 10%) during the breeding period. Phillips (1986) reported that only 6.7% of the observation time of breeding units was devoted to foraging. Herrero and Hamer (1977) noted that in Banff National Park, both members of a mated pair reduced their food intake for several weeks during the breeding season despite the fact that their energy reserves were probably depleted from the recent denning period. Hornocker (1962) reported that the dominant male at the Trout Creek dump in Yellowstone rarely fed while defending his mate from other suitors. However, Pearson (1975) felt that feeding continued to govern the activities and movements of mated grizzlies even during the breeding season. Females continued to search for food and males followed, although the males did not always forage.

Limited observations are available on habitat use by mated pairs. Murie (1981) reported that the movements and habitat use of mated bears in Denali National Park varied a great deal depending on the timing of the union. Pairs which mated during a food transition period might relocate from, for example, a favorite rooting area to an area providing green forage. Similarly, Stelmock (1981) reported that grizzly pairs which he observed in Denali were found in the areas where spring foraging items were most abundant. He speculated that this pattern of habitat use enhanced the probability of encounter between potential mates. Phillips (1986) found that in the Arctic National Wildlife Refuge, breeding units were most often seen in areas frequented by large numbers of caribou. On the Rocky Mountain East Front, some courtship associations remained in low elevation spring habitat while others moved to secluded, mountain ridges and foothills at, or above, snowline (Aune and Stivers 1983, Aune et al. 1986). Herrero and Hamer (1977) noted that the ability of a male grizzly to herd and confine a female to a particular summit ridge during the breeding period was partially a function of the topography and habitat in the mating area.

Duration of Pair Bonds

Murie (1981) reported that in Denali, the duration of pair bonds ranged from about 1 week to a maximum of 23 days. Dean (1976) documented 1 male: female association in Denali National Park that lasted for 42 days. In contrast to these relatively long pairings, copulation is sometimes preceded by little or no prior association. Hornocker (1962) reported that only the dominant and subdominant males were observed defending particular females at the Trout Creek dump in Yellowstone National Park. Other males were either "opportunity breeders" or associated with estrous females for brief periods (several days) only. However, Craighead (1972) reported that some subdominant males in Yellowstone travelled with individual females for periods of up to 2 weeks. Research at the Black Lake study area on the Alaskan Peninsula suggested that males spent very little time with females during the breeding season. There were no resightings of the same male: female pair within a season (Modafferi 1984). Egbert (1978) reported that at McNeil River Falls, mating could occur "within seconds" of a male's approach to an estrous female.

Breeding Structure and Reproductive Strategies

The nature of the breeding structure (i.e., monogamous vs. polygamous) and duration of the pair bond may depend in part on the density and distribution characteristics of the bear population. In most areas, both male and female grizzly bears will associate with more than 1 mate during a single breeding season. Observations of males consorting or mating with more than 1 female are provided by Hornocker (1962), Dean (1976), Murie (1981), Stelmock (1981), Modafferi (1984), Aune (1985), Aune et al. (1986) and Phillips (1986). Observations of females mating with more than 1 male are provided in Hornocker (1962), Sparrowe (1968), Craighead et al. (1969), Lindermann (1974), Egbert and Stokes (1976), Murie (1981), Craighead and Mitchell (1982) and Modafferi (1984). Murie (1981) and Modafferi (1984) observed adult females consorting with 2 adult males at the same time. Craighead and Mitchell (1982) noted that grizzly bears were definitely polygamous in Yellowstone National Park and were probably polygamous wherever they congregated or were abundant enough to allow estrous females to meet more than 1 male. Individual females observed at the Yellowstone dumps often mated with 2 males in 1 day and 2 females were observed to mate with 4 males in one day. Estrous females were attracted and receptive to almost all males (Hornocker 1962).

Herrero and Hamer (1977) noted that bears adapted their mating strategies according to the prevailing social structure. Where bears are highly concentrated and suitable mates are easily located, pair bonds may be of short duration. Conversely where bears are more widely dispersed, potential mates may be more difficult to locate. Once a "good" mate is found it may be beneficial for both sexes to remain together until copulation and insemination are achieved.

Furthermore, males may derive additional benefits from a protracted association. The probability of a male siring a mate's cub is inversely related to the number of males which copulate with that mate (litter mates need not have a common father). Consequently, by remaining with the female and thwarting the advances of other males, a male may increase his own fitness. In so doing, however, he forfeits other reproductive opportunities and risks losing a contest to a superior male (Bunnell and Tait 1981).

Tending of 1 female by a male may not necessarily prevent that male from mating with other females (Stelmock 1981, Murie 1981). Stelmock (1981) documented "post-copulatory" guarding by a male grizzly in Denali National Park which would be consistent with Bunnell and Tait's (1981) hypothesis. Conversely, in some other cases described in the literature, a male's attraction to a female waned soon after copulation (Hornocker 1962, Sparrowe 1968, Herrero and Hamer 1977, Murie 1981).

The sex ratio of a population may also influence courtship behavior. In populations with a shortage of reproductively available females, the best reproductive strategy for males may be to remain with a single female and defend her from the surplus of far-ranging males (Herrero and Hamer 1977, Modafferi 1984). However, the ratio of adult females to adult males at the Trout Creek dump in Yellowstone was 1: 1.59, yet brief, opportunistic relationships were the norm. As Herrero (1978) observed, the fact that even the dominant male at Trout Creek was unable to successfully guard his mate from reproductive advances by other males suggests that isolation and defense of a single female was not a viable reproductive strategy at such high densities. In populations with a surfeit of available females, a polygymous arrangement may be favored (Modafferi 1984).

Stringham (1984) suggested that grizzly bear females might also benefit from breeding with multiple males. Since adult males should theoretically refrain from aggression directed at their own progeny, a female can protect her offspring from intraspecific aggression by copulating with several males and confusing them as to their actual paternity.

Physiological considerations may also favor a protracted courtship. Herrero and Hamer (1977) noted that since evidence suggests that grizzly bears, like black bears, are induced ovulators (Wimsatt 1963), a period of interaction prior to copulation might be required to initiate ovulation. This interaction need not necessarily be by the male that eventually copulates with the female. Murie (1981) suggested that the increased tolerance by a female grizzly to a male's advances late in the breeding season might correspond to the onset of sexual receptivity during estrous.

Copulation and Implantation

Craighead and Mitchell (1982) characterized grizzly bear copulation as "vigorous and prolonged." The copulatory act and associated behavior varied considerably with the female's age, receptivity and number of males attempting to associate with her.

Duration of copulations reported in the literature varied greatly. Hornocker (1962) reported that the length of 41 copulations observed in Yellowstone National Park ranged from 5-41 minutes and averaged 16-20 minutes. Craighead et al. (1969) found that 49 copulations averaged 23 minutes in length and ranged from 10-60 minutes. Stelmock (1981) reported that in Denali National Park, the length of 15 copulations varied from 2.4 - 27.0 minutes and averaged 7.0 minutes. Other durations reported in the literature were 43 minutes (Herrero and Hamer 1977), 17 minutes (Lindermann 1974), 25 minutes (Sparrowe 1968), 5-8 minutes (mean=6 minutes) (Schleyer 1983), and 26 minutes (Mundy and Flook 1965).

The typical copulatory position was for the male to clasp the standing female with his forelegs anterior to her hind legs (Hornocker 1962, Mundy and Flook 1965, Schleyer 1983). Roop (1980a) described an exceptional variation in which the female lay on her back with the male above her. Several researchers reported that during copulation, periods of pelvic thrusting were alternated with periods of quiescence (Mundy and Flook 1965, Hamer and Herrero 1977). Brief (2-15 second) periods of accelerated movement or "quivering" thrusts may occur singularly or intermittently (Sparrowe 1968, Herrero and Hamer 1977, Stelmock 1981, Phillips 1986). Some descriptions noted that the female moved from side-to-side or in a circular motion during copulation (Herrero and Hamer 1977, Hamer et al. 1980, Schleyer 1983). Multiple mounting, with or without confirmed copulation, was frequently observed (e.g., Hornocker 1962, Lindermann 1974, Herrero and Hamer 1977, Hamer et al. 1980, Schleyer 1983). Hornocker (1962) reported that some males copulated with a single female up to 6 times in 1 evening.

Wimsatt (1963) provided conclusive proof that, in black bears, implantation of the blastocyst is delayed for up to 5 months after ovulation. Several studies have shown that discontinuous embryonic development also occurs in the grizzly bear. Unimplanted blastocysts were recovered from the uterine horns of 2 Yellowstone females 50 days and at least 30 days, respectively, after mating (Craighead et al. 1969, Craighead and Mitchell 1982). Hensel et al. (1969) reported that reproductive tracts taken from mature females in November contained corpora lutea of pregnancy but no evidence of implantation. This suggested that embryonic development began after November, presumably near the start of winter denning. Pearson (1975) recovered unimplanted blastocysts from the uterus of a female on October 21 after she had already entered the winter den.

POPULATION CHARACTERISTICS

AGE/SEX

Age and sex data for North American grizzly bear populations are presented in Tables 8 and 9, respectively. Unless otherwise indicated, ratios in the tables were calculated from capture records or visual observations. Populations without a designated legal hunting season (in the primary study area) are so indicated in the table.

Capture records rather than harvest data were used in Tables 8 and 9 to avoid some of the inherent biases of harvest age/sex ratios (see Caughley 1974, Bunnell and Tait 1980,1985, Paloheimo and Fraser 1981, Fraser et al. 1982, Harris 1986). However, capture records may also be biased due largely to unequal catchability of certain segments of the population. For example, Miller and Ballard (1980,1982) found that females and cubs through 2-years old, were underrepresented in capture records. Some of the difficulties in intrepreting harvest ratios are discussed in a subsequent section.

Sample sizes upon which the age and sex ratios in Tables 8 and 9 were based varied enormously between studies (from 12 bears for the Mission Mountains to over 400 bears for the Black Lake study area on the Alaskan Peninsula): in some cases, particular age/sex classes were represented by a single individual. Population characteristics based on such small samples should be considered as tentative.

Table 10 gives the age of the oldest grizzly bear recorded for several North American populations. The oldest bear reported was a 28.5 year old female in the western Brooks Range of Alaska (Reynolds and Hechtel 1984B), accompanied by a 3-year old offspring.

POPULATION DENSITIES

Table 11 presents data on densities of North American grizzly bear populations. The technique used to derive the density estimate for each study is given in the table. A discussion of the common methods used to estimate population size, density and trend is provided in a subsequent section.

Estimated densities as reported in the literature were lowest in the Arctic study areas of the Tuktoyaktuk Peninsula (211-262 sq. km per bear). Highest densities were reported for Kodiak Island (1.52-4.0 sq. km per bear) and Admiralty Island (3.2-4.2 sq. km per bear). Discussions of the major habitat characteristics for each ecosystem are provided in a subsequent section.

Stringham (1984) considered the relationship between habitat (coastal vs. inland), latitude and density of grizzly bear populations. He found that for 5 inland populations, latitude accounted for 96% of the variation in density. However, densities for 2 coastal Alaskan populations were considerably greater than predicted from the regression of density on latitude for inland populations. Latitude and habitat type together accounted for only 48% of the variance in density when all 7 populations (including inland and coastal) were considered. As Stringham (1984) observed, the exceptionally high densities given for Kodiak Island by Troyer and Hensel (1964, 1969) resulted from surveys of high seasonal bear concentrations within their 248 sq. km Karluk Lake study area. These densities may not be representative of the year-round distribution. Stringham (1984) also noted that inter-area comparisons might be improved by expressing density in terms of biomass (calculated from mean weight of bears in each age-sex class) and by incorporating habitat suitability considerations in the analysis.

Table 8. Age ratios of North American brown/grizzly bear populations. All ratios compiled from capture records unless otherwise specified.

Ecosystem, Area and Citation	% Adults (n;age)	% Subadult (n;ages)	% Yearling (n)	% Cubs (n)	Comments
Yellowstone Ecosystem					
(Craighead and Mitchell 1982)	43.6 (77;5+)	24.9 (44;2-4)	13 (23)	18.5 (33)	pre-dump closure; 1959-1967 data
(Knight et al. 1985)[a]	57 (55;5+)	25.5 (25;2-4)	14.5 (14)	3 (3)	post-dump closure; ratios constructed from captured bears known or believed to be alive in 1984
Northern Continental Divide Ecosystem					
Glacier Natl. Park[a] (Martinka 1974)	68%: adults and subadults combined (48)		15	17	sample sizes represent mean number sampled over 5 survey years (1967-71)
Rocky Mountain Front (Aune et al. 1986)	31.6 (55;5+)	24.7 (43;2-4)	23.6 (41)	20.1 (35)	1980-85 data
Mission Mountains (Servheen 1981)	50 (6;5+)	16.7 (2;2-4)	8.3 (1)	25 (3)	1976-79 data

Table 8. (Continued)

Ecosystem, Area and Citation	% Adults (n;age)	% Subadult (n;ages)	% Yearling (n)	% Cubs (n)	Comments
North and South Forks of Flathead (Jonkel 1982)	50	25	25	0	1976-79 data
Canadian Rockies					
Akamina-Fishinena/N. Fork of Flathead (McLellan 1984)	43.4 (46;4+)	23.6 (25;2-3)	17.9 (19)	15.1 (16)	1980-83 data
Jasper Natl. Park[a] (Russell et al 1979)	67 (16;6+)	29 (8;2-5)	0 (1)	4	1975-78 data
Coastal British Columbia					
Kimsquit River Valley (Hamilton and Archibald 1984)	46.7 (7;6+)	53.3 (8;2-5)	0	0	1982-83 data
Northern Interior					
Mackenzie Mtns. NWT (Miller et al. 1982)	51.1 (43;7+)	24.2 (16;2-6)	10.4 (8)	14.3 (11)	based on aerial observations ("random encounters"), 1971-77
SW Yukon: Kluane Natl. Park[a] (Pearson 1975)	43.7 (18;7+)	31.7 (13;2-6)	17.1 (7)	7.3 (3)	1965-67 captures: age structure constructed for 1969
Boreal Forest					
Swan Hills, Alberta (Nagy and Russell 1978)	20.8 (5;6+)	58.4 (14;2-5)	8.3 (2)	12.5 (3)	1975-77 data
Canadian Artic					
Northern Yukon (Nagy et al. 1983a)	55.6 (103;7+)	23.8 (44;2-6)	9.2 (17)	11.4 (21)	1973-74 data; light harvest rate
NWT: Tuktoyoktuka/Peninsula Richards Island (Nagy et al. 1983b)	36.5 (115;7+)	34.6 (109;2-6)	13.3 (42)	15.6 (49)	1974-77 data
Arctic Alaska					
Eastern Brooks Range (Reynolds 1976)	51.4 (56;7+)	21.1 (23;2-6)	18.3 (20)	9.2 (10)	1973-74 data
Western Brooks Range (Reynolds 1984)	47.3 (53;5+)	24.1 (27;2-4)	11.6 (13)	17 (19)	1977-78 captures: age structure constructed for 1987
Interior Alaska					
Alaska Range (Reynolds and Hechtel 1984a)	44.9 (31;6+)	24.6 (17;2-5)	14.6 (10)	15.9 (11)	constructed for 1982 based on capture and hunter kill data
South Central Alaska					
Upper Susitna (Miller and Ballard 1980)	45.3 (24;5+)	28.3 (15;2-4)	22.6 (12)	3.8 (2)	1979 data
Susitna Hydro Project (Miller 1985a)	42.6 (40;5+)	34.0 (32;2-4)	6.4 (6)	17.0 (16)	1980-85 data
Alaskan Peninsula					
Black Lake (Glenn 1975)	25.6 (143;5+)	34.3 (192;2-4)	15.0 (84)	25.0 (43)	1970-74 data; cub ratio calculated from aerial survey data; others from capture records

Table 8. (Continued)

Ecosystem, Area and Citation	% Adults (n;age)	% Subadult (n;ages)	% Yearling (n)	% Cubs (n)	Comments
Kodiak/Afognak					
Terror Lake Hydro Project (Smith et al. 1984)	46.8 (45;5+)	29.2 (28;2-4)	16.7 (16)	7.3 (7)	1982-83 data
Karluk Lake (Troyer and Hensel 1969)	24.5 (43;4+)	29.5 (52;2-3)	21.6 (38)	24.4 (43)	1959-64 data
Southwest Alaska					
Admirality Island (Schoen and Beier 1986)	78.5 (33;5+)	16.7 (7;2-4)	4.8 (2)	0	1981-84 data
Admirality and Chichagof Island (Schoen and Beier 1986)	69.8 (44;5+)	27 (17;2-4)	3.2 (2)	0	1983-85 data
Hood Bay, Admirality Island (Wood 1976)	52.2 (24;5+)	28.3 (13;2-4)	6.5 (3)	13.0 (6)	1971-74 data

[a]No formal hunting season in main study area.

Table 9. Sex ratios reported for North American brown/grizzly bear populations.

Ecosystem, Area and Citation	Adults M:F	Adults (n)	Subadults M:F	Subadults (n:ages)	Yearling M:F	Yearling (n)	Cubs M:F	Cubs (n)
Yellowstone Ecosystem								
Craighead and Mitchell 1982 (1959 data)	46.3:53.7	(577)	57.7:42.3	(44:2-4)	63:37	(44)	59:41	(78)
Knight et al. 1986a								
1975-85 data:	50:50	(205)	60:40	(174:2-4)	—	—	55:45	(78)
1975-79 data:							71:29	
1980-84 data:							43:57	
Northern Continental Divide Ecosystem								
North and South Forks of Flathead River (Jonkel 1982)	66.7:33.3	(12)	12.5:12.5	(6:2-4)	33.3:66.7	(6)	—	—
Mission Mountains (Servheen 1981)	50:50	(6)	0:100	(2:2-4)	0:100	(1)	33.3:66.7	(3)
Rocky Mountain Front (Aune 1985, Aune et al. 1986)	28.9:71.1	(45)	62.5:37.5	(24:2-4)	66.7:33.3	(9)	—	—
Canadian Rockies								
Akamina-Kishinena/Flathead (McLellan 1984)	46:54	(46)	52:48	(25:2-3)	50:50	(19)	—	—
Jasper Natl. Park[a] (Russell et al. 1979)	72:28	(18)	50:50	(2:2-5)	—	—	—	—
Coastal British Columbia								
Kimsquit River Valley (Hamilton and Archibald 1984)	43:57	(7)	75:25	(8:2-5)	—	—	—	—
Northern Interior								
Mackinzie Mountains (Miller et al. 1982)	41.2:58.8	(34)	53.6:46.4	(28:2-6)	100:	(3)	100:	(2)

Table 9. (Continued)

Ecosystem, Area and Citation	Adults M:F	(n)	Subadults M:F	(n:ages)	Yearling M:F	(n)	Cubs M:F	(n)
Boreal Forest								
Swan Hills, Alberta (Nagy and Russell 1978)	100:0	(1)	61.5:38.5	(13:2-5)	0:100	(2)	—	—
Canadian Artic								
Northern Yukon (Nagy et al. 1983A)	51.5:48.5	(103)	42.5:57.5	(40:2-6)	30:70	(10)	—	—
NWT: Tukloyatuk/Richards Island (Nagy et. al 1983B)	31.3:68.7	(115)	53.4:46.6	(88:2-6)	69:31	(29)	66.7:33.3	(24)
Arctic Alaska								
Eastern Brooks Range (Reynolds 1976)	48.2:51.8	(56)	38.8:61.2	(18:2-6)	50:50	(4)	—	—
Western Brooks Range (Reynolds 1984)	43.4:56.6	(53)	45:55	(20:2-4)	28.6:71.4	(7)	75:25	(4)
Interior Alaska								
Alaska Range (Reynolds and Hechtel 1984a)	41.9:58.1	(31)	41.2:58.8	(17:2-5)	66.7:33.3	(9)	42.9:57.1	(7)
South Central Alaska								
Nelchina/Upper Susitna (Miller and Ballard 1980)	58.3:41.7	(24)	66.7:33.3	(15:2-4)	66.7:33.3	(12)	100:0	(2)
Susitna Hydro Project (Miller 1985a)	40:60	(40)	50:50	(32:2-4)	66.7:33.3	(6)	50:50	(16)
Alaskan Peninsula								
Black Lake (Glenn 1975)	15.4:84.6	(143)	46.9:53.1	(192:2-4)	47.6:52.4	(84)	50:50	(24)
Kodiak/Afognak								
Karluk Lake (Troyer and Hensel 1969)	23.3:76.7	(43)	51.9:48.1	(52:2-3)	47.4:52.6	(38)	51.2:48.8	(43)
Terror Lake Hydro Project (Smith et al. 1984)	31.1:68.9	(45)	53.6:46.4	(28:2-4)	25:75	(16)	42.9:57.1	(7)
Southwest Alaska								
Admiralty Island (Schoen and Beier 1986)	24.2:75.8	(33)	85.7:14.3	(7:2-4)	50:50	(2)	—	—
Hood Bay, Admiralty Island (Wood 1976)	16.7:98.3	(24)	30.8:69.2	(13:2-4)	100:0	(3)	50:50	(6)

[a]No formal hunting season in main study area.

Table 10. Oldest brown/grizzly bears recorded for various North American populations.

Ecosystem, Area, Citation	Age (yrs.)
Yellowstone Ecosystem	
(Craighead and Mitchell 1982)	25.5
(Knight et al. 1985)	22
Northern Continental Divide Ecosystem	
North Fork of the Flathead River (Jonkel 1982)	16.5
South Fork of the Flathead River (Jonkel 1982)	13.5
Rocky Mountain Front (Aune et al. 1986)	24.5
Mission Mountains (Servheen 1981)	16
Canadian Rockies	
Jasper Natl. Park (Russell et al. 1979)	20
Interior British Columbia	
Revelstoke Area (Simpson et al. (in prep))	18
Glacier Natl. Park, BC (Mundy and Flook 1973)	23
Coastal British Columbia	
Kimsquit River Valley (Hamilton and Archibald 1984)	17
Northern Interior	
SW Yukon: Kluane National Park (Pearson 1975)	24
Mackenzie Mountains, NWT (S.J. Miller et al. 1982)	23
Boreal Forest	
Swan Hills, Alberta (Nagy and Russell 1978)	22
Canadian Arctic	
Northern Yukon (Nagy et al. 1983a)	25
Arctic Alaska	
Eastern Brooks Range (Reynolds 1976)	24.5
Western Brooks Range (Reynolds and Hechtel 1984b)	28.5
Interior Alaska	
Alaska Range (Reynolds and Hechtel 1984a)	25.5
Southcentral Alaska	
Susitna Hydor Project (Miller 1985)	21.5
Copper River Delta (Campbell 1985)	15±1
Alaska Peninsula	
Black Lake Area (Modafferi 1984)	21
Kodiak/Afognak	
Terror Lake Hydro Project (Smith et al. 1984)	25.5
Southeast Alaska	
Admirality Island (Schoen and Beier 1986)	23

REPRODUCTIVE RATES

The factors contributing to the reproductive rate of a population include mean litter size, mean age at initial reproduction, mean interval between litters and mean maximum age of reproduction (Craighead et al. 1974). Table 12 summarizes reproductive data for North American grizzly bear populations as reported in the literature (data were generally lacking for maximum age of reproduction and are therefore not included in the table). Comparisons of these reproductive parameters among populations should be done with caution. Sample sizes and duration of sampling periods vary widely (Table 12), data on successive litters of individual females are lacking (Stringham 1980) and different methods have been employed in estimating age at first reproduction and breeding interval. (For further discussion on the limitations of comparing available data, see Stringham 1980, 1984).

Factors Influencing Reproductive Rate

General relationships between habitat features, food availability and reproductive potential are described herein. The effects of annual climatic variation and food availability are discussed in the section on population regulation.

As Stringham (1984) observed, most analyses of the relationships between reproduction/recruitment vs. food supply and nutrient-energy balance have been constructed using surrogate indices of food supply such as latitude or bear weight rather than actual data for the controlling factors. Hence, conclusions drawn from these studies are tentative.

Body weights may be used as a "surrogate index" of food supply and nutrient energy of populations. Blanchard (in press) found a high correlation between mean adult female weight and mean cub litter size for 8 North American grizzly populations. She also found a moderately high negative correlation between mean adult female weight and age at first cub production. In general, females in those populations with reliable, high value foods (meats and berries) during summer and fall attained greater size, matured earlier and had larger litters than females with relatively low value foods (roots).

Similarly, Stringham (in press b) found that body size was a good predictor of the mean rate of reproduction and, probably, juvenile survival. For 10 grizzly bear populations, variations in body weight corresponded strongly with variations in productivity (number of cubs per adult female per year).

Bunnell and Tait (1981) compared the reproductive rates of coastal and interior grizzly populations and found that coastal populations (which had access to spawning salmon) had larger litter sizes, earlier maturation and heavier female weights. They also found a correlation between litter sizes and latitude of den sites. They attributed the lower northern latitude litter sizes to reduced primary productivity.

Stringham (1984) reached similar conclusions. He found that litter size, productivity, reproductive vigor (net effects of reproductive rate on population growth rate) and indices of maturation rate to weaning and to puberty, were all negatively correlated with latitude. Like Bunnell and Tait

Table 11. Reported densities for North American brown/grizzly bear populations.

Ecosystem, Area and Citation	Pop. Density (sq. km/bear)	Comments/methods
Yellowstone Ecosystem		
(Craighead and Mitchell 1982)	80.3	pre-dump closure (1959-1970); direct count of individually recognizable animals; projection from mathematical computer model
(Blanchard and Knight 1980a)	50	post-dump closure; based on number of unduplicated bears sighted; an optimistic estimate of 350 bears in 20,000 sq km.
Northern Continental Divide Ecosystem		
Glacier National Park (Martinka 1974)	21.2	direct count; unduplicated sightings of identifiable bears and family groups
Mission Mountains (Servheen 1981)	49	direct count of radio-collared bears and young plus observations of unmarked bears
Mission Mountains (Dood et al. 1986)	137	recalculated from data of Servheen (1981) using only marked and identifiable animals and their composite home range with a boundary strip added (See Dood et al. 1986, p. 48-49)
South Fork of Flathead River (Dood et al. 1986)	49	recalculated from above data; see comments for Mission Mountains, Dood et al. 1986
Rocky Mountain East Front (Aune et al. 1986)	71.6-74.2	marked bears only
	51.1	marked and observed bears included (area for both estimates determined from 98% of adult relocations excluding non-habitat.)
Rocky Mountain East Front (Dood et al. 1986)	158	recalculated from above data; see comments for Mission Mountains, Dood et al. (1986)
Cabinet-Yaak Ecosystem		
Cabinet Mountains (Kasworm 1985)	44	determined from number of identified grizzlies within polygon encluding all captures and sign
Canadian Rockies		
Jasper Natl. Park (Russell et al. 1979)	85.5-101.6	direct count (captured and accompanying bears plus other identifiable bears)
Banff National Park (Vroom 1974)	79-120.5	unverified, cited in McLellan (1984)
Akamina-Kishinena/North Forks of Flathead (McLellan 1984)	10-15.6	direct count of captures and observed bears; range of counts over 4 years; "rough estimate"
Interior British Columbia		
Revelstoke Area (Simpson et al. in prep.)	32	direct counts, captures and sightings
Glacier National Park, B.C. (Mundy and Flook 1973)	28	direct count (captured and observed)
	18	Schnabel method
Boreal Forest		
Swan Hills, Alberta (Nagy and Russell 1978)	139	direct count (captured and observed)
	104	based on number of known females and young on study area and estimate of males using 50:50 sex ratio
Northern Interior		
SW Yukon: Kluane National Park (Pearson 1975)	22.8-27.2	aerial surveys (identifiable animals with most of home range in study area)
Mackenzie Mountains, NWT (Miller et al. 1982)	86	based on captures, aerial surveys (random encounters) and projection from observed sex ratio and age ratio (see pp. 67-71 in Miller et al. 1982)

Table 11. (Continued)

Ecosystem, Area and Citation	Pop. Density (sq. km/bear)	Comments/methods
Canadian Arctic		
NWT: Tuktoyaktuk Peninsula/Richards Island (Nagy et al. 1983b)	211-237 255-262	spring density fall density both estimates from marked bears and direct counts
Northern Yukon (Pearson 1976)	48	from number of marked and identifiable females and young and estimate of malesusing assumed 50:50 sex ratio
Northern Yukon (Nagy et al. 1983a)	33-39	ratio of marked to unmarked (bears with home ranges in study area)
Arctic Alaska		
Eastern Brooks Range (Quimby and Snarshi 1974)	173 (137-304)	direct counts: aerial transects along valleys within 4 river systems
(Quimby 1974)	120 (83-160)	Lincoln/Peterson index for mountainous portion of Canning River drainage
(Curatolo and Moore 1975) (Canning, Ivishak and Echooka drainages)	148	minimum density from marked bears and young in 9234 sq km area
(Reynolds 1976)	148 260	intensive study area only (high quality habitat) region wide both estimates from direct counts of marked and identifiable bears
Western Brooks Range (Reynolds 1984; Reynolds and Hechtel 1980)	42-44	intensive study area only: observed minimum population
Interior Alaska		
Alaska Range (Reynolds and Hechtel 1984a)	35.0-52.9	"probable density" based on captures, observations, hunter kills and inference for additional, unrecorded bears (minimum density = 54 km 2 per bear)
Denali National Park (Dean 1976)	24-38	direct count: unduplicated sightings of individual bears and family groups; 4 counts (1957-1959, 1973)
Southcentral Alaska		
Susitna River Hydro Project (Miller 1985a)	34.4	Lincoln/Peterson Index (aerial counts) for predefined search area, adjusted for unequal capture probabilities
Nelchina/Upper Susitna (Miller and Ballard 1982)	41	Peterson index, corrected for biases
Copper River Delta (Campbell 1985)	14-16.3	marked and harvested bears
Alaska Peninsula		
(Glenn: pers. commun. as cited in Miller and Ballard 1982)	16	method not specified: presumably from marked:unmarked ratios as per Glenn (1975)
Kodiak/Afognak		
Karluk lake Area (~248 sq. km) Entire Kodiak Island Kodiak Natl. Wildlife Refuge (Troyer and Hensel 1969)	1.52 ~3.75 ~3.40	Schnabel method; optimal habitat rough estimate/extrapolation rough estimate/extrapolation
Terror Lake Hydro project (Smith and Van Daele 1984)	4	Direct count: cumulative total of captures and unduplicated sightings over 10-month period (2.8 km 2/bear) in 900 km 2 high-density area)
Southeast Alaska		
Northern Admiralty Island (Schoen and Beier 1986)	3.2-4.2	marked:unmarked ratios; early summer aerial surveys of alpine areas

Table 12. **Reproductive characteristics of North American grizzly bear populations.**

Ecosystem, Area and Citation	Mean litter Size (n)	Mean age of first parturition (n)	Breeding Interval (n)	Comments
Yellowstone Ecosystem				
(Craighead amd Mitchell 1982)	2.24 (68)[a]	5.6 (16)[b]	4.3 (68)[c]	pre-dump closure (1959-1970)
(Knight et al. 1985)	1.90 (104)	6.2 (12)	3.0 (33)	post-dump closure (1974-1982)
Northern Continental Divide Ecosystem				
Rocky Mountain Front (Aune 1985, Aune et al. 1986)	2.23 (30)	5.5 (2)	2.0 (est.)	
Mission Mountains (B.I.A. files; from Dood et al. 1986)	2.12	5.5	3.3	
North Fork of Flathead (Jonkel pers. commun: in Dood et al. 1986)	2.66	5.0	—	
Glacier Natl. Park (Martinka 1974)	1.70	—	—	
Canadian Rockies				
Akamina-Kishinena/N. Fork of Flathead (McLellan 1984)	2.5 (8)	6 (est.)	3.4 (5)	
Jasper Natl. Park (Russell et al. 1979)	2.0 (3)	5-7 (est.)	—	
Interior British Columbia				
Glacier Natl. Park, B.C. (Mundy and Flook 1970, 1973)	2.0 (143)	—	2-3 (some 4)	
Revelstoke Area (Simpson et al. in prep.)	2.33 (3)	—	—	
Northern Interior				
SW Yukon: Kluane Natl. Park (Pearson 1975)	1.70 (11)	7.8 (6)	3+	
Mackenzie Mtns. NWT (Miller et al. 1982)	1.83 (6)	8.0[d] (32)	3.8 (11)	
Canadian Arctic				
Northern Yukon (Nagy et al. 1983a)	2.0 (6)	6.6-7.5 (15)	3-4 (4)	
NWT: Tuktoyoktuk Peninsula/Richards Island (Nagy et al. 1983b)	2.3 (28)	6.4 (20)	3.3 (8)	
Arctic Alaska				
Eastern Brooks Range (Reynolds 1976, Reynolds and Hetchel 1980)	1.78 (13)	9.6 (19)	4.24	
Eastern Brooks Range: Canning River (Quimby 1974)	1.6 (69)	—	—	
Western Brooks Range (Reynolds and Hetchel 1980)	2.03 (23)	8.4 (11)	4.03 (est.)	
Central Brooks Range (Crook 1971)	2.0	—	—	

Table 12. (Continued)

Ecosystem, Area and Citation	Mean litter Size (n)	Mean age of first parturition (n)	Breeding Interval (n)	Comments
Interior Alaska				
Alaska Range (Reynolds and Hechtel 1984a)	2.03 (23)	8.4 (11)	4.03 (est.)	
Denali Natl. Park (Murie 1981)	1.85 (68)	—	—	
South Central Alaska				
Susitna Hydro Project (Miller 1984)	2.1 (19)	—	—	
Nelchina/upper Susitna (Spraker et al. 1981)	2.8 (4)	4.7 (6)	—	
Alaskan Peninsula				
McNeil River (Glenn et al. 1976)	2.5 (41)	6 (8)	3.6 (12)	
NcNeil River (Lentfer 1966)	2.13 (24)	—	—	
Black Lake (Glenn 1973)	2.3 (200)	5.2	~3 (est.)	
(Klein 1985)	2.2	—	—	
Kodiak/Afognak				
Terror Lake Hydro Project (Smith and Van Daele 1984)	2.30 (4)	—	—	
Kodiak Natl. Wildl. Refuge (Barnes 1985)	2.21 (14)	—	—	
(Troyer and Hensel 1969)	2.23 (98)	4-5	3 (est.)	
Southwest Alaska				
Admiralty Island (Schoen and Beier 1986)	1.84 (19)	8 (4)	—	
Admiralty, Baranof and Chichagof (Klein 1958)	2.2 (79)	—	—	

[a]number of litters in sample
[b]number of females in sample
[c]number of cycles in sample
[d]youngest observed age, not mean age of first reproductive

(1981), he attributed this to the decline in primary productivity and longer, harsher winters at higher latitudes. The same reproductive indices tended to be higher on Alaskan coasts than in inland habitats in Alaska and northern Canada. However, since the coastal populations he examined were also at a lower latitude than the inland populations, the differences in reproductive indices may have arisen from either lower latitude or availability of food (salmon and marine mammal carrion). Latitude and habitat type together accounted for at least 74% of the variance in body weights in grizzly bears 4 years of age or older and, as noted earlier, bear weight is highly correlated with reproductive parameters.

Other researchers found that some reproductive rate differences between interior populations were related to nutritional differences. Reynolds and Hechtel (1984) compared reproductive rates in the western and eastern Brooks Ranges. They concluded that the higher rate in the western Brooks Range resulted from access to traditional caribou calving grounds. Caribou calves and carrion provided bears in the western Brooks Range with a high protein food source in early spring when other foods were low in nutrition and energy demands were high. Aune (1985) noted that along the Rocky Mountain East Front, litter sizes south of the Sun River (n=3) were smaller than those in the more productive habitat north of the Sun River (n=16).

Stringham (1980) suggested that bears in high quality habitats may undergo selection for genotypes promoting large litter sizes. There also may be selection for genetic polymorphism where carrying capacity and hence optimal litter size fluctuates year to year. Russell et al. (1979), Nagy et al. (1983a) and Dood et al. (1986) noted that low reproductive rates may be inherent in populations also having low mortality and recruitment rates.

Positive correlations between garbage availability and reproductive performance have been noted for several areas. Bears with access to garbage matured earlier (Nagy and Russell 1978, Knight et al. 1986), had larger litter sizes and bred more frequently than bears in similar habitat without access to garbage (Rogers 1978 [black bear data], Knight et al. 1986). Access to garbage has also been shown to positively influence bear weight (Rogers et al. 1976, Russell et al. 1979, Blanchard in press) which is, in turn, correlated with reproductive success (Rogers 1976, 1978, Blanchard in press). Correlations between dump closure and reproductive rate depression in the Yellowstone grizzly bear population are discussed in the section on Population Regulation.

POPULATION REGULATION

Because of the rich demographic database available for the Yellowstone population from the Craighead studies (1959-1971) and the Interagency Grizzly Bear Study Team research (1974-1986) and because of the vigorous controversy surrounding the impacts of dump closure on this population, much of the literature devoted to grizzly bear population regulation focuses on the Yellowstone bears. Stringham (1980, 1983, 1984, in press a) presented the results of an elaborate set of analyses (and an exhaustive literature review) concerning the effects of various environmental and biological factors on grizzly bear population dynamics. A number of his analyses dealt with the Yellowstone grizzlies and the factors responsible for the reproductive rate depression which followed closure of the open-pit garbage dumps. Stringham's work should be consulted for a more definitive treatment of these aspects of bear biology.

Population regulation generally pertains to maintenance of a stable mean (either density or density relative to habitat carrying capacity) with only brief deviation from that mean (Stringham 1984). Shaffer (1978) reviewed the major findings on population regulation in bears. He noted that there were 2 major views on how bear population's were regulated. One view held that bear populations were self-regulated by social (intrinsic) factors while the other view supported environmental (extrinsic) regulation primarily through effects of food supply. Shaffer (1978) felt that these mechanisams were generally related, and hence, were best regarded as a hierarchy of controls rather than as alternative means of population regulation. While extensive factors determine the resource base available to any bear population, intrinsic factors determine the extent to which the resource base could be subdivided. Shaffer (1978) noted that observations at McNeil River, Alaska, were of intraspecific behaviors. Egbert and Stokes (1976) found that aggression by brown bears depended on the abundance of spawning salmon which supported this view.

Bunnell and Tait (1981) reached similar conclusions. They suggested that a broad but consistent pattern of population regulation was found in the genus *Ursus*. Nutritional conditions dominated the reproductive rate, and social mechanisms regulated access to sources of nutrition. Thus, both density-independent (nutritional regulation) and density-dependent (social) mechanisms appear to be implicated in bear population regulation. These mechanisms are discussed in greater detail in subsequent sections.

Extrinsic (Nutritional and Climatic) Regulation

Evidence for nutritional regulation of reproductive rates has been found in both black and grizzly bear populations. Rogers (1976, 1978) studied black bears in northern Minnesota and reported that well-fed captive bears and garbage-fed wild bears matured earlier than wild bears with little or no access to garbage. Within the latter group, only 1 of 9 females produced her first litter following a year of food scarcity. Furthermore, some multiparous females which were expected to produce cubs failed to do so following poor food years.

Reproductive performance was correlated with pre-denning weight for females 3.5 years of age or older. Females weighing less than 67 kg in October all failed to produce cubs while 28 of 30 females weighing more than 80 kg produced cubs. Females of intermediate weights had varied reproductive performance. Stringham (in press a) reported that, based on weight data for 10 grizzly bear populations, comparable body weights for grizzly bear females were 95 kg for the mean body weight below which reproduction did not occur and 180 kg for maximum reproductive output.

Spring weights of black bear cubs were also positively correlated with female pre-denning weight. Rogers (1976) suggested that bears physiologically assessed their supply of stored nutrients in the fall and prevented embryo implantation when stores were insufficient to support themselves and their young through the denning period.

Jonkel and Cowan (1971) and Beecham (1980) also found that black bears with nutritionally superior diets matured earlier, had larger litters and shorter breeding intervals than bears with poorer diets. Beecham (1980) concluded that climate, and its influence on habitat, was the primary extrinsic factor governing long-term population size. Social and reproductive systems were governed by the quality and quantity of available food and its spatial and temporal distribution.

Picton (1978) found a strong correlation between an index of climate (plus carrion availability) and litter size of Yellowstone grizzly bears. His analysis indicated that the depression in reproductive rate which followed closure of the park dumps (from 2.2 cubs per litter during 1959-69 down to 1.8 cubs per litter during 1972-76) was largely due to unfavorable climatic conditions. A subsequent analysis (Picton and Knight in press) demonstrated the predictive capability of the climate-carrion regression and provided an updated index to incorporate 1977-81 litter size data. Picton et al. (1986) developed seasonal climate scores which, along with season-specific habitat quality indices, were used to explain between year differences in food habits, movements, mortality and weight gain. Nutritional regulation of reproductive rates was not specifically discussed.

Stringham (in prep.) reevaluated Picton's climate-carrion index (CCI) and disputed his conclusions. He disagreed with Picton (1978) on 5 points:

1. climatic change accounted for only about half of the observed litter size decline
2. the years selected to represent the pre-closure period included 2 cohorts affected by dump closure
3. the carrion index actually contributed very little to the correlation with litter size
4. additional evidence and inference which substantiated the impacts of dump closure on the nutritional status and reproductive parameters of the population
5. the statistical method upon which Picton (1985) based his conclusions failed to adequately separate the effects of climatic variation from dump closure. Stringham (in prep.) using multiple regression, determined that only about 31% of the observed 0.37 cubs/litter decline (1959-68 vs. 1972-81) was accounted for by climate while 70% of that decline could be attributed to dump closure. J. Craighead et al. (1976a) also concluded that the drop in reproductive rate after closure resulted from loss of the stable, reliable food source at the dumps.

Stringham (in press a) developed an alternative index to integrate the effects of climate and garbage availablity on nutrient supply and energy balance for Yellowstone grizzlies from 1959-81. Graphical presentation showed a strong relationship between his food/nutrient balance index for the postnatal period (infancy) and recruitment of cubs-of-the-year. Furthermore, postnatal balance continued to influence each cohort until adulthood. Stringham (in press a) extended his analysis to consider the effects of food supply per unit bear mass (i.e., kg food/kg grizzly) and found an even stronger relationship between this index and reproduction and recruitment. When mean individual nutrient-energy balance was high for Yellowstone grizzlies, many cubs were produced. These cohorts had high rates of recruitment to adulthood and were predominantly male. Conversely, when energy balance was low, few cubs were produced and these predominantly female cohorts had low recruitment to adulthood. In either case, later changes in nutritional conditions did not modify the recruitment rate.

McCullough (1981) presented a different interpretation on regulation of sex ratios for Yellowstone grizzlies suggesting that size of the adult population was the controlling factor. Overall, a disproportionate number of males were present at conception. When adult populations were low, cub production and survivorship to adulthood were high leading to an increase in the proportion of males as the number of adults increased. At higher adulthood population age structures, cub production was low, male survivorship declined drastically and the proportion of males in the population decreased as the total adult population declined.

Intrinsic (Social) Regulation

Impetus for research into the role of density dependent compensatory mechanisms affecting grizzly bear reproductive rates stemmed from disagreement about the status of the Yellowstone grizzly bear population following closure of the garbage dumps (Cowan et al. 1974, Craighead et al 1974). The computer model developed by the Craighead team to describe the population dynamics of the Yellowstone population assumed that no compensatory processes were operative (Craighead et al. 1973, 1974, McCullough 1981). They contended that for a long-lived species with delayed maturity, compensatory processes (e.g., increased litter size, shorter reproductive cycle or higher subadult survival) would act slowly. Furthermore, population regulatory mechanisms (infanticide and hormonal regulation of estrus intervals) could offset compensatory processes (Craighead et al. 1976, Craighead and Mitchell 1982).

Cole (1974) argued that the decrease in litter size after dump closure resulted from increased breeding by younger aged females. These females, formerly prevented from breeding by older, more dominant females, produced smaller litters, thereby lowering the average litter size. Knight et al. (1985, 1986) reported that smaller litters did typify the first reproductive cycles of young female grizzly bears in the Yellowstone ecosystem.

Cowan et al. (1974) reviewed the available demographic data for Yellowstone grizzlies and concluded that failure to incorporate compensatory mechanisms into the Craighead model rendered their population predictions suspect. They noted that the grizzly bear was characterized by attributes of a strongly K-selected species — long life span, delayed maturity, extended parental care, nonreproductive intervals and high adult survivorship. Although grizzly bears were limited in the range of compensatory response that was possible, Cowan et al. (1974) felt that increased adult mortality (as occurred following dump closure) would be offset by compensatory increases in juvenile recruitment.

Avrin (1976) and McCullough (1981) reanalyzed the data from Craighead et al. (1974) and found that the number of juveniles recruited was strongly compensatory, with high populations of adults (postnatally) recruiting few juveniles and low numbers of adults recruiting high numbers of juveniles. McCullough's (1981) analysis revealed that both litter size and proportion of reproducing females contributed to the variation in juvenile recruitment. The delay of sexual maturity until age 5 resulted in an oscillatory tendency with a periodicity of about 10 years in the relationship between the adult and juvenile segments of the population. Regression of recruitment rate on number of adult males resulted in a highly significant correlation, suggesting that adult males were responsible for most of the suppression of cub recruitment.

Similarly, Shaffer (1978,1983) found that the percent of females which reproduced and the average litter size were significantly correlated with adult population size. However, unlike McCullough (1981), the strongest correlation was with the number of adults prenatally (at the time of breeding).

Stringham (1980, 1983, 1984, in press a) also examined the role of adult males in grizzly bear population regulation. Stringham (1980) found that the differences in reproductive potential among 6 North American bear populations were directly related to differences in food supply and density, but negatively correlated with differences in proportions of adult males. As did McCullough (1981), he found that, in Yellowstone National Park, there was a

strong negative correlation between numbers of adult males during a given year and number of offspring. Stringham (1983, 1984, in press a) expanded on this latter finding. The years when adult males were most abundant were years with the smallest litter sizes and fewest number of litters. Cohorts born during years of peak adult male abundance also showed the highest attrition rates to at least 2.5 years of age (Stringham 1983). However, Stringham (in press a) noted that it was difficult to distinguish between the nutritional impacts caused by dump closure and the coincidental increase in male abundance. Considering only the period preceding dump closure, the addition of a male abundance factor to a regression model already containing a climate index did not appreciably improve the correlation with litter size. Stringham (in press a) postulated that as dump closure reduced the amount of food available to the population, the contemporaneous increase in adult male abundance lowered the proportion of the reduced food supply available to adult females and younger bears. The proportion and number of females reproducing each year was apparently less sensitive than litter size to variation in food supply and number of males.

There are several alternative explanations to account for the apparent inverse relationship between cub production and recruitment vs. density of adult males at Yellowstone dumps. Stringham (1983) noted that the correlation could actually be an artifact of conducting censuses at dumps. Adult male abundance appeared highest when the natural food supply was lowest because that was the period when more males regularly fed at the dumps. Another possibility is that females with cubs avoided the dumps when and where adult males were most abundant. Stringham (1984) found that other aspects of the census procedure corrected for dump avoidance by females with cubs. Furthermore, cohort size and litter size were correlated with prenatal as well as postnatal density of adult males.

Additional evidence for regulation of bear populations by adult males comes from black bear studies near Cold Lake in northeastern Alberta. Kemp (1976) postulated that aggression toward subadults by adult males had a strong regulatory effect. The experimental removal of 26 large adult males was followed by a major increase in the bear population (from 80 in the pre-manipulation period to 175 in the post-manipulation period). The recapture rate, and presumably, ingress and survivorship of subadults also increased. A followup study conducted 3 years after the removal experiment (Young and Ruff 1982) indicated that the population declined to 137 bears as the adult male segment was partially restored. The fact that there was no decrease in the average weights of bears during the post-removal period suggested that food was not in short supply at the higher densities. In another often cited black bear study, Jonkel and Cowan (1971) found evidence that a northwestern Montana bear population was regulated by a combination of nutritional factors which affected reproductive success, and intrinsic factors (adult male aggression) which influenced subadult dispersal.

Mechanisms by which adults could regulate, or at least limit to some degree, grizzly bear population densities include killing conspecifics; enforced eviction of subadults, females with cubs or other conspecifics from the more productive foraging habitats; and, repelling potential immigrants (Bunnell and Tait 1981, McCullough 1981, Stringham 1984). Reports of intraspecific mortality and theoretical advantages to adult bears from "prudent cannibalism" (Rogers 1978) were discussed in a previous section: also see discussions on hierarchies, territorial behavior and subadult dispersal. Stokes (1970) noted that the rise in cumulative stress levels associated with increased density and social intolerance can upset hormonal balances in the adrenal pituitary-gonad system. This can lead to reduced breeding and maternal care.

Population regulation by adult females has also been proposed in the literature. Examples of intraspecific mortality by adult females and maternal infanticide were previously discussed. Knight et al. (1985, 1986) suggested that maternally-induced infanticide could liberate a female from an energy deficit state under unfavorable conditions. They theorized that sex-specific infanticide could be expected under stressful conditions accompanying a population near carrying capacity. Because females are generally the key to determining population growth, killing female cubs would tend to reduce existing population pressures.

Tait's (1980) discussion of cub abandonment as a reproductive tactic in grizzly bears may have some theoretical bearing on the Knight et al. (1985, 1986) hypothesis. Tait (1980) found that under certain circumstances, females with a single cub might best enhance their individual fitness by abandoning the cub and entering a new reproductive cycle. As noted previously, Reynolds and Hechtel (1984) reported that 3 females which lost their cubs in early spring were available for reproduction soon thereafter. Both of the above reproductive tactics, maternal infanticide and abandoment, might provide mechanisms for females to tailor their reproductive investment according to prevailing nutritional and social context.

Carrying Capacity

Carrying capacity, K, may be defined as the density of organisms at which the net reproductive rate (average number of offspring produced by an organism during its entire lifetime) equals 1 and the intrinsic rate of increase of a population equals 0. At densities below K, the population grows and at densities greater than K declines (Pianka 1978). Grizzly bears show characteristics typical of strongly K-selected species (Cowan et al. 1974).

In the conterminous United States, recovery goals for the grizzly bear have been established to maintain at least a minimum viable population, MVP, within each ecosystem. However, estimates of the carrying capacity for these ecosystems are needed to determine if the area within each delineated recovery zone is sufficiently large to sustain an MVP (Edge 1985, Servheen 1986).

Edge (1985) discussed the concept of carring capacity as it pertained to grizzly bears and suggested approaches for determining K. He noted that habitat quality was the ultimate factor determining grizzly bear carrying capacity. Habitat quality depends, in turn, on the quality, quantity and distribution of foods; the juxtaposition of cover; and, human-related disturbance factors. Edge (1985) considered 3 potential approaches for estimating qrizzly bear carrying capacity. He felt that the present knowledge of grizzly bear nutrition was insufficient for constructing a nutrition-based carrying capacity model as has been done with ungulates. An estimate based on the rate of subadult male

dispersal was also rejected due to uncertainty of how dispersal related to carrying capacity. Edge (1985) concluded that an index based on the mean home range size and degree of overlap for adult females was the most promising approach. Potential problems with this method included obtaining adequately large samples representative of an entire ecosystem and selection of an appropriate home range model. This technique is discussed in greater detail in Edge (1985).

PARASITES, DISEASES AND OTHER NATURAL MORTALITY FACTORS

DISEASES

Researchers have substantiated the susceptibility of grizzly bears to Brucellosis in both field studies and experimental investigations. Neiland (1975) and Zarnke (1983) found serologic signs of exposure to rangiferine brucellosis in bears preying or scavenging on caribou herds in Alaska. Experimentally, grizzlies have been contaminated with *Brucella suis* (type 4) via food rations (Neiland 1979). Whether or not rangiferine brucellosis adversely affects bears is unknown, but it is suspected to impact reproduction as in other species (Neiland and Miller 1979).

Also bacterial in nature, Leptospirosis is less well understood. In Alaskan grizzlies, Zarnke's (1983) research indicated a prevalence in older animals suggesting that the probability of previous exposure is directly related to age. The kidney and reproductive tract infections, known to result in moose and caribou, could also pertain to bears, however, additional research is needed to substantiate this effect.

Several other infectious diseases are reported to occur in grizzly bears: Clostridium (Williamson et al. 1965), Toxoplasmosis, canine distemper, and rabies (Fowler and Theobald 1978). In addition, researchers have reported incidences of noninfectious diseases such as neoplasms (Moulton 1960, Wallach 1978) and hypothyroidism (Russell 1970). While some research has been conducted on these illnesses, further information is needed on their prevalence and impacts, if any, on natural populations.

PARASITES

Endoparasites

Of public health and bear management concern is the occurrence of *Trichinella* in grizzly populations. In most studies, researchers have recorded infestations in over 50% of bear populations (Pearson 1968b, Choquette et al. 1969, Greer 1969-1972b, 1974, 1975, 1976a-1980, 1982-1983, Ott 1984, Greer 1985). Maintained through ingestion of infected meat via cannibalism and scavenging (Worley et al. 1974), encysted *T. spiralis* have been found in consistently high concentrations in the tongue, masseter, diaphragm and femoral muscles of grizzlies (Ott 1984). With larval densities surpassing those considered lethal to humans, Ott (1984) suggests that infestations could be sufficient to affect the nervous system and possibly cause abnormal behavior in bears.

Baylisascaris spp. have been established as the grizzlies' most common intestinal parasites (Browne 1962, Pearson 1968b, Choquette et al. 1969, Greer 1969-71, 1974, 1975, 1978, Wallach 1978). The apparent loss of these intestinal parasites each year before denning and the reinfestation upon emergence in spring is believed to be due to dietary changes (Mundy 1963, Choquette et al. 1969, Mundy and Flook 1973).

Although not as frequently, grizzly bears are susceptible to several other nematode genera, as well as 2 cestode genera (Table 13). In addition, Wallach (1968) and Greer (1972) cite occurrences of intestinal flukes, but these trematodes are considered rare parasites of grizzlies.

Ectoparasites

Grizzly bears are relatively free of ectoparasites being host to only 2 genera of fleas: *Chaetopsylla* (Holland 1949, Pearson 1968b, Worley 1976) and *Arctopsylla* (Browne 1962, Greer 1969), as well as 1 tick species: *Dermacenter andersoni* (Rogers and Rogers 1976).

Table 13. Nematode and Cestode parasites of the grizzly bear.

Class	Genus	Citation (s)
Nematoda	Ancylostoma	Wallach 1978
	Dochmoides	Pearson 1968 Choquette et al. 1969
	Dirofilaria	Pearson 1968 Choquette et al. 1969 Greer 1974 Craighead and Mitchell 1982
	Urcinari	Browne 1962 Greer 1970,1971,1974 Craighead and Mitchell 1982
Cestoda	Taenia	Mundy 1963 Pearson 1968 Greer 1971,1972,1974,1975 Wallach 1978 Craighead and Mitchell 1982
	Diphyllobothrium	Mundy 1963 Pearson 1968 Choquette et al. 1969 Greer 1970,1971,1972

OTHER NATURAL MORTALITY FACTORS

Predation/Cannibalism

According to Archibald (1983), mortality of grizzly bears through predation is attributable almost exclusively to conspecifics. While large male predation upon smaller individuals is most frequently observed (Reynolds 1978, Reynolds and Hechtel 1982, Nagy et al. 1983a, 1983b), Knight et al. (1978) documented cannibalism within a litter of cubs that had been abandoned. Mundy and Flook (1973) proposed that the frequency of this behavior may be a function of population density. Consequently, decreasing habitat could cause cannibalism to become even more prevalent.

Malnutrition

As Reynolds and Hechtel (1982) point out, cubs of the year sustain the highest mortality rate with the loss of entire litters being common. In fact, Nagy et al. (1983b) reported cub mortality to be as high as 75% in parts of Canada. Because the majority of these deaths occur during denning or within 1 to 4 weeks of emergence, researchers believe the primary agent to be malnutrition (Roop 1980a, Nagy et al. 1983b, Roop 1983, Knight et al. 1985). Once past the second year, mortality drops to 25% (Nagy et al. 1983b). In adults, nutritionally-related deaths become almost negligible (Martinka 1970, Herrero 1982) with the exception of reproducing females in areas, or periods, of low habitat productivity (Knight et al. 1986).

Accidental Deaths

In addition to disease, diet and predation factors, occasional accounts of accidental deaths for all age classes have been recorded (Kolz et al. 1978, Nagy et al. 1983b). However, the rarity of these observations indicates their minor role in population dynamics.

INTERSPECIFIC RELATIONSHIPS

IMPACTS FROM LIVESTOCK AND OTHER AGRICULTURAL IMPACTS

Types of Impacts/Relationships

Impacts to grizzly bears from agriculture and livestock could be categorized into 5 classes:

1. Direct loss: mortality or loss of grizzly bears through control actions, relocations and illegal kills associated with livestock allotments, ranching or farming operations.
2. Indirect loss: habituation of grizzly bears to human activity following attraction to livestock, livestock carrion, crops, etc., predisposing them to nuisance behavior elsewhere.
3. Habitat loss or modification due to grazing or other agricultural activity.
4. Displacement (temporally or spatially) away from agricultural activity.
5. Direct competition with livestock for preferred forage species.

General

Storer and Tevis (1955) and Brown (1985) discussed the "undeclared war" between early stockmen and the grizzly in California and the southwestern U.S. Intensive campaigns of hunting, trapping and poisoning culminated in the bear's eventual extinction from those regions. Conflicts with livestock were also a major factor in the decimation on the grizzly population in Mexico (Koford 1968, 1969, Leopold 1967).

Table 14 lists some of the reports which documented control actions as a direct result of conflicts with livestock or other agricultural activity. The "control kill" column includes losses from both authorized personnel and private individuals. Mortality data in the literature often lumped all "control losses" without specifying the number lost to each type of offense. In these cases, a "check" in Table 14 was used to indicate that some mortality was due to agricultural conflict but the number of bears involved could not be determined. No attempt was made to identify instances of mortality cited in that report, thus the data in Table 14 can not be used to calculate the cumulative mortality due to agricultural conflict. These data are presented merely to give a rough idea of the magnitude of agricultural impacts on the grizzly bear.

Livestock-Related Impacts

Thier and Sizemore (1981) analyzed grizzly bear relocation data from the NCDE from 1975-80. They found that livestock depredation was significantly the most common offense for which a bear was relocated. Furthermore, these relocations were significantly less "successful" (i.e., success being no return and no further conflict) than relocations after other offenses. Mace et al. (in prep) also analyzed grizzly bear relocations in the Northern Continental Divide Ecosystem and found that 44% of the relocations resulted directly from livestock depredations. Knight and Judd (1983) calculated that, dependent on which mortality and population estimates they employed, from 1.5% to 20% of the entire YGBE grizzly bear population may have been lost due to livestock conflicts in 1976-77. Lee and Weaver (1981) estimated that 10% of the YGBE population may have been lost due to livestock related conflict on the Targhee National Forest alone during 1960-1979. However, Burns (1986) noted that the pre-1980 livestock related grizzly mortality statistics were based largely grazing reports filed annually by grazing permittees and may not have accurately portrayed the actual losses. He reported only 1 grizzly bear mortality on a Targhee National Forest grazing allotment for the 1980-84 period.

Knight et al. (1985) reported that depredations (livestock and property) were the leading cause of nonhunting mortality in the NCDE from 1975 to 1984. Eighty-nine percent of these mortalities specifically involved sheep depredations. Aune and Stivers (1983) reported that from 1977-1982, 5 grizzly bears on their Rocky Mountain East Front study area were known to prey on sheep; all 5 were subsequently killed.

Unreported grizzly bear mortality related to livestock operations may be a significant part of the overall mortality. Jorgensen (1979) reported that only 41% and 17% of known bear kills in 1976 and 1977, respectively, were ever reported. Griffel (1978) likewise found that some herders were either incommunicative or provided erroneous information concerning depredations. Knight and Judd (1983) noted that the grizzly's threatened status under the Endangered Species Act may have contributed to this problem. Stockmen, cognizant of the stiff penalties for poaching a grizzly and dissatisfied with the preferred policy to relocate rather than dispatch a depredating bear (Anonymous 1979, USFS 1985e), may be more reluctant to report depredation conflicts than before listing. Other stockmen may be inclined to inflate the extent of their depredation loss although losses due to other factors, such as poor herding practices, may greatly exceed predator loss (Griffel 1982).

One critical question is whether or not some bears can peacefully coexist with livestock without serious depredation conflicts. Traditionally, many stockmen felt that all bears were livestock-killers and should be eliminated from grazing allotments and ranches (Griffel 1978, Schallenberger and Jonkel 1980). Knight and Judd (1983) reported that all instrumented bears (except 1 orphaned cub) that came into contact with sheep killed them. However, Claar et. al. (in press) found that only 2 of 20 marked grizzly bears in the Mission Mountains (NCDE) were involved in sheep depredations although almost all were in proximity to livestock during spring and fall. Several investigations observed that depredation behavior was apparently a learned process (Johnson and Griffel 1982, Jorgensen 1983, Knight and Judd 1983). This may account for some of the regional differences in depredation as might the previous level of control (Johnson and Griffel 1982).

Hunter and Gunson (1980) and Gunson et al. (1985) documented livestock-related grizzly bear mortalities in Alberta. Nielson (1975) and McCrory and Herrero (1982) discussed the historical conflict between agricultural activ-

Table 14. **References which documented agriculturally-related depredation and control actions. Numbers in control columns indicate number of grizzly bears involved in that category of control action.**

	Livestock				Control			
Ecosystem, Area and Citation	sheep	cattle	other or unspecified	Property Depred.	Kill	Reloc.	Capture, Release or other	Comments
Yellowstone								
Knight and Judd (1985)	x	x	horse		22			data for 1970-75
Targhee Natl. Forest								
Griffel (1976)	x						3	
Griffel (1977)	x						x	
Griffel (1978)	x				x		x	
Jorgensen (1979)	x							
Lee and Weaver (1981)	x	x			19			
Griffel (1982)	x				7			
Johnson and Griffel (1982)	x						4	
Franklin and Matejko (1983) (Island Park)	x		x	x		3	x	
Jorgensen (1983)	x						x	data for 1976-77
Matejko and Franklin (1983)	x					3		
Matejko (1985)	x				3	6	3	
Northern Continental Divide								
Flathead Indian Reservation								
Frost (1985)			x	x				
Claar et al. (in press)			x		x	2		
Rocky Mountain East Front								
Aune and Stivers (1981)	x	x				3		
General (location not specified)								
Anon. (1942)			goat					control not specified
Brown (1959)	x	x	x	x	x			
Brown (1960)	x	x			x			
Brown (1960)	x	x	swine					control not specified
Greer (1970,1971,1976,1979, 1980,1981,1982,1983)			x	x	x	x		
Alberta								
Hunter and Gunson (1980)	x	x			x	x		data for 1970-79
Gunson et al. (1985)	x			x	25			data for 1972
Alaska								
Kodiak/Admirlty Islands								
Eide (1965)		x			19			
General								
Lentfer (1965)		x			8			
Lentfer (1966)		x			8+			
Lentfer (1967)		x			5			
Lentfer (1968)		x			10			

ity and grizzly bears in Alberta. Horejsi (1986) noted that the expansion of agricultural activity in prime grizzly bear habitat in Alberta posed a serious threat to these bear populations. This threat was multi-faceted, involving land clearing, permanent inhabitations and demand for stock protection from predators.

Griffel and Basile (1981) and Murie (1948) discussed means to identify livestock kills by bears. Jorgensen (1979) reviewed the literature on grizzly predatory techniques. Unfortunately, even when a confirmed grizzly predation has occurred, the culprit bear may still be difficult to identify. Since bears are fairly easy to capture around sheep carcasses, many control kills and relocations may handle innocent bears (Griffel 1978, Jorgensen 1983). Thus, even though some individual grizzlies may be capable of coexisting with livestock, it is evident that few bears can coexist with the livestock/human complex.

Most livestock depredation incidents in the contiguous United States involve sheep, although some grizzlies will prey on cattle (Lee and Weaver 1981, Knight and Judd 1983). Cattle depredation was traditionally a major problem on Kodiak Island, Alaska (Eide 1965). The larger size of the Kodiak brown bears undoubtedly accounts for much of the difference. Knight and Judd (1983) noted that all 4 grizzlies which killed adult cattle in their study were adult males, although 2 sows did prey on calves. Cattle depredation may also be less detectable than sheep depredation because cattle are not generally herded as closely as sheep nor are they checked as frequently (Knight and Judd 1983).

Grizzlies also feed on livestock carcasses either scattered on rangeland or dropped in "boneyards" by ranchers (Servheen et al. 1981, Aune and Stivers 1983). Claar et. al. (in press) suggested that historically the grizzly/human relationship was partially symbiotic as bears ate livestock carrion and ranchers benefitted from carcass removal. In the NCDE, bear use of boneyards is greatest in spring and many provide a valuable food resource when other foods are scarce prior to spring green-up (Schallenberger and Jonkel 1980, Servheen 1981). There is disagreement in the literature concerning whether or not grizzly use of livestock carrion may lead to active depredation of live animals. It is generally accepted, however, that improperly situated boneyards may function much like garbage dumps and attract grizzlies to areas near human habitation where they are increasingly vulnerable (Schallenberger and Jonkel 1980, Servheen et al. 1981, Aune and Stivers 1983).

Direct competition for forage between grizzlies and livestock was discussed in a number of reports. Jorgensen (1979, 1983) developed a "competition index" to identify food plants for which bears and sheep might compete. Twenty-four of the 31 plant groups she examined had a "potential" for competition (i.e., both bears and sheep consumed the plant). Competiton was likely to be greatest in the spring when succulent, palatable vegetation was least available and concentrated in particular areas. Most of Jorgensen's data pertained to black bears, however, and she noted that sheep competition with grizzlies would probably be less than sheep competition with black bears (Jorgensen 1979).

Schallenberger (1976) noted that cattle appeared to compete directly with grizzly bears for forage on more mesic sites. Competiton with sheep for certain forb and shrub species was also possible, particularly if the sheep were loosely herded and allowed to concentrate on moist areas. Based on U.S. Forest Service ratings of desirable range plants, he listed forage species for which grizzlies and livestock might compete. He did not provide quantitative data on livestock forage items.

Summerfield (1978) felt that there was little competition for food between grizzly bears and cattle in part of the Idaho Panhandle National Forest. He attributed this to spatial and temporal segregation and the grizzlies broad food base. He also reported that competiton for cover was unlikely. Davis (1986) reported that most herbaceous grizzly bear foods were also listed as forage plants for domestic livestock (taken from U.S. Forest Service data).

Perhaps the most extensive analysis of grizzly bear-livestock forage competition was undertaken by Aune for the Rocky Mountain East Front area in northern Montana (Aune and Stivers 1983,1985, Aune et. al. 1984). Aune et. al (1984) found that over 50% of 1379 grizzly bear radio locations occurred on areas where the predominant land use was livestock grazing. Aune (1985) compared the food habits and habitat use of grizzly bears and cattle along the Rocky Mountain East Front. He found that 2 species commonly shared 6 habitat components with the riparian component being used most commonly by both. A food habits comparison (using fecal analysis) showed some degree of overlap in the diets of cattle and grizzly bears. A use:availability analysis of 3 preferred habitat components of grizzly bears showed no significant difference in the use of grazed versus ungrazed components. However, Aune noted that numerous years trampling and overgrazing in riparian areas actually reduced the diversity of plant species and increased the abundance of low-palatibility species. Cattle browsing on aspen suckers potentially threatened the aspen community on his study area and caused a subsequent loss of the palatible forb understory.

Lee and Jonkel (1980) reported that intensive livestock grazing, primarily cattle, had induced significant modification of the riparian vegetation within portions of the Pine and Antelope Butte wetlands (NCDE). Soil compaction by livestock had resulted in predestaling and puddling in some areas. They also noted that major shifts in species composition of trampled areas (fewer succulent forbs and perennial graminoids) could render the wetlands less desirable as bear habitat. Other researchers have also commented on the effects of livestock trampling (Schallenberger 1976, Aune and Stivers 1983, Jorgensen 1983).

Other (Non-Livestock) Agricultural Impacts

Most of the data in the literature concerning non-livestock agricultural impacts pertains to control kills of nuisance or depredating grizzlies. Reports which specifically mentioned agriculturally related control actions are indicated in Table 14. The particular attractant which lead to complaints of confrontation was not usually specified.

Hunter and Gunson (1980) reported that 24 of 137 grizzly bear complaints in Alberta (1970-1979) were from farms. A recent survey of residents in the Mission Valley (NCDE) indicated that of 30 respondents who had experienced some "problem" with grizzly bears, 5 reported damage to fruit and orchards and another 4 reported damage to fences, buildings, etc.

The most common non-livestock attractants leading to control actions were apparently apiaries and fruit orchards. Schallenberger and Jonkel (1980) reported that many of the apiaries along the Rocky Mountain East Front were situated in riparian habitats where the potential for grizzly encounters was greatest. Few apiaries were equipped with deterrent devices. Agricultural depredations may increase dramatically in years when there is a shortage of natural foods. Knight et. al. (1982) reported that 6 grizzly bears were relocated from a single fruit orchard following a year with low winterkill, poor pine-nut crop and low rainfall.

Lee and Jonkel (1980) discussed the impact on grizzly habitat greatly from the development of water resources in the Pine Butte wetlands. They found that old irrigation systems had a marked effect on adjacent plant communities and on the occurrence of hydrophillic plants in drained areas.

INDUSTRIAL IMPACTS

The 2 industrial activities (excluding timber extraction) of foremost concern to grizzly bear management are hydrocarbon exploration and development, as well as hydroelectric development. Mining activities and geothermal development are important in certain areas but there is little literature on impacts of these activities.

Potential impacts common to these types of industrial activities include:

1. Construction or upgrading of roads providing increased access into grizzly bear habitat and consequent escalation of human activities (e.g., hunting, recreation) in both frontcountry and backcountry areas. (The impacts associated with road construction were covered in another section. It is assumed that the general conclusions regarding road impacts apply regardless of the purpose for which a road was constructed).
2. Increased human activity related directly to project construction or maintenance.
3. Increased availability of artificial attractants (especially garbage) and possibly increased legal and illegal grizzly bear mortality due to both of the above.
4. Possible displacement or disruption of normal behavior patterns (including denning, movements and habitat use) due to increased human activity, construction, operation of industrial equipment or habitat modification.
5. Direct habitat loss due to road construction, buildings, etc. or, with regards to hydroelectric development, more extensive habitat loss from impoundments.
6. Increased aircraft disturbance. (Aircraft impacts are discussed in a seperate section although grizzly bear reactions to aircraft, especially to seismic helicopters, were frequently mentioned in the industrial-related literature.)
7. Physiological disturbance/arousal not accompanied by overt behavioral response.

Hydrocarbon Exploration and Development

Overview of Impacts and Magnitude of the Problem

M. Bromley (1985) discussed the general sequence of operations and types of activities related to oil and gas exploration and development. These may be divided into 5 main phases;

1. preliminary exploration — including seismic testing
2. exploratory drilling — including construction of temporary access roads, preparation of well-site, provisions for water and drilling
3. development — including drilling facilities, wellhead and pumping equipment, storage facilities, treatment facilities, disposal facilities, construction of adequate road network and electric transmission lines communication
4. production
5. reclamation or abandonment — restoration of impacted area to pre-disturbance or improved status.

The impacts to wildlife vary by each phase and may be largely site-specific (M. Bromley 1985).

Nielson (1975) reviewed the status of the plains and boreal forest grizzly bear in Alberta. She concluded that development of oil fields in the Swan Hills region was largely responsible for the 50% reduction in the grizzly bear population from the early 1950s to the mid 1970s. The rapid influx of seismic and construction crews, the establishment of over 100 "bush camps" and the building of an extensive road network into previously inaccessible areas were the primary factors. Improperly handled garbage attracted grizzlies to the camps where they were easy targets for camp workers.

Nagy and Russell (1978) also noted that petrochemical exploration and development was one of the most important economic factors affecting the Swan Hills area. The "labyrinth" of oil field roads related to this development provided nearly complete access into Swan Hills grizzly bear habitat. Hunter and Gunson (1980) reported that 20% of the grizzly bear complaints in Alberta from 1970-79 were industry-related (including complaints from oil rig sites, construction units and logging camps).

Oil and gas development during the last 15-20 years has had a significant impact on certain populations of the barren-ground grizzly bear in Arctic Canada. The combined impacts of seismographic testing, temporary and permanent construction camps, airstrips, communication towers, drilling rigs, extensive road networks, generating plants and related construction activities have influenced grizzly bear distribution around the Tuktoyoktuk Peninsula and Richards Island, Northwest Territories (Nagy et al. 1983b). Hunting was considered to be the most severe impact in both of these areas.

Spurned by highly productive oil and gas fields in similar geologic formations in Alberta, Utah and Wyoming hydrocarbon exploration activity in the overthrust belt of Montana has escalated significantly. As of 1977, lease applications for oil and gas development had been filed for greater than 404,858 ha of federal and other land with federal subsurface rights. Some of these leases have been filed within occupied grizzly bear habitat (Schallenberger 1980). Oil and gas exploration and development combined with the effects of associated roads, recreational use and construction activity constitute a major disturbance factor for grizzly bears along portions of the Rocky Mountain East Front (Lee and Jonkel 1980, Schallenberger 1980). A recent environmental assessment for a proposed drilling site in the area included the following observation:

> "Common to all concerns about the effect of oil and gas activities on wildlife behavior, is our limited capability to predict effects before activity begins. Oil and gas activities in ecosystems like those in the study area are a fairly recent development." (U.S. Forest Service and Bureau of Land Management 1985).

Impacts of Seismic Testing and Drilling

McLellan and Mace (1985) studied the reaction of 11 different grizzly bears of various age and 6 classes to several types of seismic disturbances including crews stringing cable, helicopters stringing cable, tracked vehicles drilling shot holes and seismic blasting. Reactions to 3 instances of on-ground activity varied greatly. Several bears moved nearer to the activity site (including 1 male which moved within 100 m of ongoing blasting) while others ventured nearer and then left the area. Based on 7

observations of 5 bears, the authors concluded that there was no indication of avoidance of seismic activity.

In another case, the reactions of 4 bears to drilling and blasting and heavy helicopter traffic near preferred foraging habitat were studied (1985) Mclellan and Mace. All 4 bears used the area within 500 m of the seismic line less than when there was no disturbance. A female with 2 cubs avoided the 500 m zone during the disturbance but seemed to be relatively undisturbed by the helicopter traffic 1000-2000 m distant. Although the investigators concluded that disturbance from seismic activity was evident within the 500 m zone, they noted that 3 difficulties arose in interpreting these data. These are:

1. distinguishing between "natural" movements (e.g., to better foraging areas) and seismic-influenced movements was not easy,
2. it was difficult to determine the distance at which bears could see or hear the stimuli and
3. those bears with the strongest escape reaction might be overlooked because they fled from initial disturbances before monitoring began.

Aune (1984) and Aune et. al. (1984) studied the responses of grizzly bears along the Rocky Mountain East Front to seismic testing. They concluded that grizzlies did appear to distribute themselves temporally and spatially to avoid seismic activity. Mean distances of bear relocations to the nearest active seismic line was 9.7 and 8.1 km in 1983 and 1984, respectively. Similar to the grizzlies studied by McLellan and Mace (1985), individual bears differed significantly in their tolerance to seismic activity. Some bears showed minimal reaction to seismic activity or support helicopters; others vacated particular drainages while seismic blasting was taking palce. One subadult male tolerated seismic activity less than 3/4 mile distant while he was involved in a series of sheep depredations (Aune et. al. 1984). An adult female demonstrated decreasing reactions to seismic blasting during the course of 4 exposures over 1½ months. After initially showing displacement reactions, by the third exposure she failed to abandon a choice foraging area while blasting was underway in the same drainage (Aune 1984). The use of motion sensing "activity collars" indicated that although some bears were not displaced by seismic testing they were temporarily agitated (Aune et. al. 1984).

Reynolds et. al. (1984) studied the physiological and behavioral responses of denning grizzly bears in the National Petroleum Reserve to seismic testing and related disturbances. Reactions were evaluated with the aid of collar-mounted temperature sensors and internal heart-rate transmitters.

They found that although none of the radioed bears abandoned their dens due to seismic explosions or other activity, all showed some degree of agitation or movement within the den. Heart-rate monitors indicated that when seismic vehicles passed within 1 km of the den, the bear's heart-rate periodically reached 40 bpm or greater (normal 12-32 bpm) much more often than when undisturbed. Reynolds and Hechtel (1980), referring to the same series of experiments, noted that agitation within the den could have serious consequences for females with newborn cubs. Geist (1978) discussed the bioenergetics of disturbance and noted that when an animal is excited, the energetic costs of increased metabolism and heart-rate can be significant. These costs must be added to the costs of locomotion, forfeited food intake and possible suboptimal habitat selection due to the disturbance.

Harding and Nagy (1980) found that grizzlies on Richards Island, Northwest Territories, often denned successfully within the general area of hydrocarbon activity. Of 35 dens which they located, 28 were within the potential impact area, including several within 1.6 - 6.4 km of active areas. Two dens were apparently disturbed and abandoned, 1 by a seismic vehicle and the other by a gravel mining operation.

Impacts of Drill Sites and Other Site-Specific Activities

Aune (1984) and Aune et al. (1982, 1983, 1984) studied the effects of drilling operations on the movements, home range and habitat use of grizzlies along the Rocky Mountain East Front. They compared the geometric activity centers (GAC's) of bears in consecutive pre- and post-disturbance years and found that grizzlies were not displaced from their seasonal ranges by drilling operations (Aune et al. 1983, 1984). Although seasonal GAC's did shift from 1 year to the next, these shifts were attributed to food availability, reproductive status and age/sex class. Grizzlies did appear to be temporarily displaced from areas immediately around active drill sites. For most bears, a minimum impact zone of about 0.8 km existed around active wells. This distance varied depending on the degree of habituation of individual bears and the cover and topography of the area. Grizzlies began to reuse the area around a drill site once human activity at the site tapered off (Aune et al. 1984). Increased road construction was considered the most serious impact of oil and gas development in the area (Aune and Stivers 1983, Aune et al. 1984).

Harding and Nagy (1980) had similar results. They concluded that although grizzlies did not avoid the general area of industrial activity, they did avoid the area within 1 km of drill sites, camps, etc. Of 13-24 grizzlies in the area, only 6 ever entered the immediate area of industrial activity. They concluded that the grizzly population had apparently adapted to existing facilities. However, as new industrial activities were introduced to the island, the population might be jeopardized. Of greatest concern was the construction of new all-weather roads, disturbance of denning bears, marginal habitat loss and relocation of problem bears from construction camps.

Hydroelectric Project Impacts

Large scale hydroelectric projects involve a wide array of associated activities each of which have potential impact to grizzly populations. These activities include road and dam construction, water diversion projects, transmission line construction, vehicle and aircraft activity and inundation of suitable habitat. The impacts of hydroelectric projects are probably comparable to the impacts anticipated from other major construction activities.

Impacts on Movements, Home Range and Habitat Use

Miller and McAllister (1982) felt that 1 of the primary impacts of the proposed Susitna River hydroelectric projects on the brown bear was the interference with seasonal

migrations which would result from lakes, access roads, borrow pits and other construction activities. Disruption of traditional movement corridors was also a suspected impact from 2 existing hydroelectric projects in northwestern Montana (Casey et al. 1984, Wood and Olsen 1984ab). Smith and Van Daele (1984) found no major disruption of interdrainage travel due to construction activities of the Terror Lake hydroelectric project (dams were still under construction at time of study).

As with hydrocarbon exploration and development, the impacts of hydroelectric construction activity varied by individual tolerance to disturbance. Overall, bear densities near major construction sites appeared fairly high during both years of the Terror Lake construction work (Smith and Van Daele 1984). During the 1982 field season, the home ranges of 16 (10 males and 6 females) bears intersected major construction activities. Bears were observed frequently by construction workers both years and certain bears appeared to be highly habituated to construction activity. Bears in 1 area appeared to show increased nocturnal activity patterns to avoid construction activity near a favored salmon fishing site (Smith and Van Daele 1984). There was some indication that grizzlies vacated particular drainages where construction was intense, but the impacts of comparable construction in different areas was largely site-specific and dependent on the mitigating influences of cover and topography. An impact zone of 3-5 km may have existed around the primary construction site at the Terror Lake dam. Overall, shifts in home range were subtle and there was no obvious correlation between home range size and construction intensity (Smith et. al 1984).

Transmission lines constructed during 1983 at the Terror Lake site may have exerted a stronger influence on bear distribution than more localized construction. At least 1 female was displaced from her traditional home range by construction of the line (Smith et al. 1984). Potential impact zones of 3-5 km and 1.5-2 km were postulated for 2 different transmission lines. Some bears may have been attracted to the cleared right-of-way beneath the lines for use as a travel corridor.

Miller and McAllister (1982) felt that disturbance of denning bears was another major impact to be expected from the proposed Susitna hydroelectric projects. Grizzlies near the Terror Lake project site denned at progressively higher elevations as construction escalated (Spencer and Hensel 1980, Smith and Van Daele 1984, Smith et al. 1984). However, the increased elevation was attributed to greater accuracy in identifying den locations rather than to displacement away from construction activity. No major den disturbances were reported for 1982-83; but in 1983-84, 1 female was definitely routed from her den and another male may have been disturbed.

The inundation of extensive areas of suitable riparian and lowland habitat is another significant impact of hydroelectric development. Specser and Hensel (1980) predicted that flooding of the 200 ha (500 acre) foraging area on the floor of the Terror River Valley and possible inundation of adjacent subalpine habitat and cover areas would be a major impact on resident brown bears. In the Susitna Valley, proposed flooding of important lowland habitats which provide early spring forage and over-wintering berries was potentially a major impact of hydroelectric development (Miller and McAllister 1982). Loss of key riparian and shrub habitats was regarded as the primary impact of 4 hydroelectric projects in northwestern Montana (Casey et al. 1984, Wood and Olsen 1984,1984ab, Yde and Olsen 1984).

Additional impacts associated with hydroelectric development include disruption of salmon spawning and brown bear feeding due to water diversions, obstruction or siltation (Miller and McAllister 1982, Miller 1983, Smith and Van Daele 1984, Smith et al. 1984); possible disruption of social mechanisms as bear distribution changes (Spencer and Hensel 1980, Casey et al. 1984); localized climatic effects from major impoundments (Miller and McAllister 1982) and reduction of ungulate prey base (Miller and McAllister 1982).

Impacts of Industrial Camps

When large temporary or permanent maintenence or construction camps are established, another factor is added to the issue of industrial impacts. Follman et. al. (1980) described the problems between grizzly bears and humans during construction of the Trans-Alaskan Pipeline System (TAPS). Grizzly bears were involved in 69 of 245 animal problems reported from 1971-79. Most concerned grizzlies lured to dumps or camps by available garbage or handouts. Contributing factors included placement of some camps in prime bear habitat and early habituation of some freeloading grizzlies. Thirteen grizzlies were killed and another 12 translocated during TAPS construction.

Miller and McAllister (1982) noted that the increase in human activity at the proposed Susitna hydroelectric project could lead to greater disturbance of brown bears and a rise in bear mortality due to hunter kills, defense kills and control actions. At the Terror Lake hydroelectric project, peek occupancy of construction camps was 480 people in 1983 (Smith et al. 1984). Although the authors found that garbage was improperly stored at some sites during both years of construction no direct mortality due to control actions was reported (Smith and Van Daele 1984, Smith et. al. 1984).

Geothermal Leasing

Geothermal development is a relatively recent and localized phenomenon and consequently the literature base is weak. A U.S. Fish and Wildlife Service biological opinion on geothermal leasing (Duncan 1978) made the following conclusions:

1. impacts on the grizzly bear from geothermal activity would increase with each successive phase of development (e.g., exploration, shallow test holes, deep well)
2. impacts during the "casual use" phase would have minimal adverse impact on the grizzly bear
3. deep well drilling would require 3-5 miles of new or upgraded road for each drill site. Numbers of employees and facilities would also increase.

Although the resource being exploited differs, many of the impacts associated with hydrocarbon drilling could apply to geothermal activity.

ROAD AND HIGHWAY IMPACTS

Problems associated with roads and increased road densities have had a major influence on grizzly bear populations and habitat use patterns in numerous, widespread areas (Tracy 1977, Elgmark 1978a, Schallenberger and Jonkel 1980, Jonkel et al. 1981, Brannon 1985). Lyon and Basile (1980) and Lyon (1984) discussed the general nature of road impacts on wildlife with particular reference to grizzly bears and ungulates. These impacts include lethal encounters, habitat modification and various stress-related behavioral adaptations. Listed below are several types of impacts:

1. Increased access for humans into grizzly bear habitat. Consequences may include increased use of adjacent backcountry areas, settlement, introduction of artificial foods and attractants and additional mortality factors.
2. Use of roads, especially secondary roads, as grizzly bear travel corridors into developed areas.
3. Direct mortality from roadkills, legal and illegal harvest and other factors resulting from increased human-bear encounters.
4. Avoidance/displacement of grizzly bears away from roads and road activity.
5. Changes in grizzly bear behavior, especially habituation, due to ongoing contact with roads and road activity.
6. Habitat loss or modification due to roads and road construction, including vegetative and topographic disturbances.

Mortality From Roads

The most direct form of road-related mortality involves grizzly bears killed by vehicles (Knight et al 1981, 1986, Greer 1985, Palmiscano 1986, Burns 1986). However, most researchers have concluded that the effects of increased human access into bear habitat, particularly increased vulnerability to legal and illegal harvest, constitute the most critical impacts of road activity on the grizzly bear (Nagy and Russell 1978, Ruediger and Mealy 1978, Smith 1978, Schallenberger 1980, Zager 1980ab, McLellan and Mace 1985). McLellan and Mace (1985) found in their southeastern British Columbia study area, that a disproportionate number of grizzly bear mortalities occurred near roads. Of 11 known mortalities, 7 bears were definitely shot and 2 others may have been poached from roads. Dood et al. (1985) analyzed all Montana grizzly bear mortality data with known locations and found that 32% of all hunting mortality and 48% of all non-hunting mortality occurred within 1.0 mile of a road (n=170 and 258, respectively).

Avoidance/Displacement by Roads

Much of the literature on road impacts concerns avoidance/displacement of grizzlies from roads. Lloyd and Flect (1977) found that in southeastern British Columbia, grizzly bears avoided areas within 0.5 miles of roads. Along the Rocky Mountain East Front, grizzly bear observations near heavily travelled roads, including those which paralleled riparian areas, were markedly absent (Schallenberger and Jonkel 1980). Analysis of 408 radio relocations and 973 other grizzly observations showed that the mean distance to automobile roads and 4-wheel drive roads was 3.4 and 6.2 km, respectively. In a poor food year, these distances decreased suggesting that grizzlies compromised security factors when stressed by food shortages.

Aune et al. (1984) also studied the influence of roads on grizzly bear distribution in the Rocky Mountain East Front. They partitioned their relocation data (n=1379 relocations) into 500 m distance zones from the nearest road (e.g., 0-499 m, 500-999 m). The analysis indicated that in all 3 seasons, the zone nearest a road accounted for more relocations than any outlying zone. These results were potentially biased by the easy researcher access along the roads (leading to a disproportionate number of relocations collected from the roads), the high density of roads throughout the study area and the presence of habituated bears. The researchers observed that grizzlies whose home range included large tracts of wilderness were found within 1 km of roads only 29.3% of the time, whereas, bears whose home range lay in more heavily roaded areas were relocated within 1 km of a road 64% of the time.

Zager (1980ab) and Zager et al. (1983) evaluated grizzy use of habitat in logged and roaded areas in northeastern Montana. No overall avoidance of roads was evident in their analyses but this may have been a result of the high density of roads throughout their study area. They observed that logged areas were more likely to be used when located along secondary and closed roads than when located along primary roads. Females and females with cubs avoided habitat within 200 m of roads, whereas, males appeared to prefer habitat adjacent to roads. Zager (1980ab) attributed the latter result to extensive travelling by males.

Another study conducted in the Cabinet Mountains of northeastern Montana (Kasworm 1985) showed that the mean distance of grizzly bear relocations from open roads (2467 m) was significantly greater than the mean distance to closed roads (740 m; $p<.001$).

Three studies included use/availability analysis to evaluate the impacts of roads on grizzly bears. In southeastern British Columbia, grizzly bears used the area within 100 m of a road an average of 40% of the expected value in spring and 50% of the expected value in summer/fall (McLellan and Mace 1985). Beyond 100 m the displacement effect was minimal or absent. No differences were detected between the effects of primary, secondary and tertiary roads. Based on the total proportion of the study area which lay within 100 m of a road, the researchers calculated that 8.5% of the total area was "lost" to bears as a consequence of road avoidance.

Aune and Stivers (1985) performed a similar use/availability analysis for 385 grizzly bear relocations from the Pine Butte Preserve (NCDE). Bears were relocated within 500 m of an open road far less than expected. The number of relocations from 500-1000 m was about equal to the expected value and the number of relocations beyond 1000 m exceeded the expected value. The apparent avoidance of roads within 0-500 m was especially noteworthy because 59.9% of the total area of the 3 most preferred habitat components occurred within this zone and most of the reloca-

tion data were from road-habituated bears. The type of road was also important. Grizzly bear observations on jeep and field roads were common while use of primary roads was rare except when artificial attractants were available.

Brannon (1984) found that in Yellowstone National Park, grizzly bears avoided areas within 50 m of a road and used the area between 3.0 and 4.5 km more than expected. Computer-generated random points were compared to the distribution of bear relocations. ANOVA tests indicated that bear observations occurred at significantly greater distances than random grid points from most "zones of influence" (distance zones from roads).

Mattson et al. (in press) also analyzed the effects of roads on grizzly bear distribution and habitat use in Yellowstone National Park. They found that primary roads and developments were situated in the most productive grizzly bear habitat in the Park. On a "micro" analysis scale (0-1500 m), primary roads depressed bear use up to 600 m in the spring. The effect was somewhat less in the summer and absent in the fall. On a "macro" scale (0-15 km) deviation of observed from expected levels of bear use in zones paralleling roads was significant for all seasons, however, the pattern of this deviation varied markedly by season. Individual classes of bears were impacted differently by road presence. Subadult bears were disproportionately represented adjacent to roads, apparently displaced out of more secure zones by dominant bears. Habitat use patterns were also affected. Whereas grizzlies tended to occupy the most productive habitat in areas beyond the conceivable influence of roads, productivity of habitat occupied by grizzlies in zones proximal to roads was depressed below the average for the zones. Grizzly bear foraging strategies were disrupted out to approximately 2-5 km in spring and summer and out to 4 km during fall.

Bears in Denali National Park also seemed to prefer areas away from roads. A comparison of paired road and off-road study plots showed consistently higher bear densities in the off-road plots. Eighty-three percent of the bears which displayed a strong reaction to road activity were within 200 m of the road; 96% were within 400 m (Tracy 1977).

In addition to general avoidance, roads may sometimes influence normal movement patterns. Miller and Ballard (1982b) found that following translocation, the return movements of 3 sows with young in southcentral Alaska were delayed or deflected by a highway. A similar case was described for 2 translocated bears in the Yukon (Spredbury 1984). Jonkel et al. (1981) noted that interference with natural movements, especially along bear travel corridors, was a major impact of roads and highways in northern Montana. Some bears may utilize secondary roads as travel routes especially when off-road travel is impeded by slash of thick vegetation (Smith 1978). Movements along secondary or closed roads can potentially lead grizzlies into developed areas and increase the chances of undesirable bear-human encounters (Ruediger and Mealey 1978).

Displacement of grizzly bears by road activity can be temporal as well as spatial. McLellan and Mace (1985) found that although there was no significant difference between day and night distances of bear relocations from roads, bears were found directly on roads more frequently at night (9.8% of 41 relocations) than during the day (0.6% of 1050 relocations). Zager (1980ab) in northwestern Montana and Aune and Stivers (1985) in the Rocky Mountain East Front also found increased use of secondary roads at night.

Factors Affecting Grizzly Bear Responses to Roads

A number of factors may influence an individual bear's reaction to roads and road activity. These factors include age/sex class of the bear, type of area (remote vs. accessible), individual habituation to road-related stimuli, nature of the stimuli and character of the habitat adjacent to the road.

Some segments of the population may be influenced by the presence of roads more than others. Zager (1980ab) felt that avoidance of roads by females with cubs was a major concern. As noted previously, Miller and Ballard (1982b) found that in southcentral Alaska, roads interferred with the movements of sows with cubs. Smith (1978) observed that no family groups were seen along roads in his coastal British Columbia study area. In Denali National Park, some family groups appeared to be thoroughly habituated to tour bus travel along the major park roads while single bears seemed to be underrepresented in areas adjacent to roads (Tracy 1977). Another study in Denali indicated that males reacted to vehicles more frequently than did other groups. Some single bears and family groups fled from vehicles and others were habituated to raod activity (Stelmock 1981). Aune et al. (1984) found that subadult bears were displaced further away from roads than adults.

Bear populations in different areas show pronounced differences in their reactions and degree of habituation to road stimuli. Smith (1978) found that all grizzly bears in his remote study area displayed a strong escape reaction. McLellan and Mace (1985) noted that "local" bears (those customarily near human activity) reacted less strongly to road activity than "remote" bears. However, local bears in remote settings reacted more strongly than remote bears in remote settings. Some grizzlies in Denali National Park demonstrated a high level of habituation to road activity. In 1973-74, 78% of all grizzly bears observed from tour buses showed no reaction to the stimuli. This included 58% of the bears sighted within 200 m of the highway (Tracy 1977). By 1982-83, the number of vehicles per day on the main Denali road had increased by 50% from the 1973-74 level while grizzly bear sightings declined 32% (Singer and Beattie in press). The researchers concluded that this decline reflected either displacement away from the road due to the increased activity or a major change in the grizzly bear population. Those bears which were seen in 1982-83 were seen closer to the road than in 1973-74 suggesting increased habituation by the remaining bears. Stelmock (1981) reported that the intensity of grizzly bear reactions to vehicles along the Denali road generally decreased during the summer. This would seem to indicate that road habituation was partially a seasonal phenomenon.

Not all road-related disturbances result in the same response by grizzly bears. Those grizzlies in Denali which fled from vehicles showed increased flight distances after vehicle restrictions prohibiting passenger cars (as opposed to tour buses only) were lifted in the fall (50.5 m vs. 95.5 m). The percent age of bears showing a flight response also increased slightly. Increasing numbers of vehicles present near a group of grizzlies also increased bear responses

(Singer and Beattie in press). In the earlier Denali study, grizzlies demonstrated the same reaction to tour buses regardless of whether sightseers were on or off the bus (Tracy 1977). Loud noises were found to increase the degree of response (Tracy 1977, Stemlock 1981).

The character of the habitat adjacent to roads may influence grizzly bear reactions to road stimuli. McLellan and Mace (1985) observed that bears in direct view of vehicles generally fled but bears close to roads but yet in some protective cover were not affected. In northwestern Montana, grizzly bear use of logged areas adjacent to roads was largely dependent on the availability of cover including a well-developed shrub strata, leave trees and an undulating boundary for the logged area (Zager 1980ab). Conversely, grizzly bears in Denali National Park appeared to feel less secure when their view of the road was obscured by vegetation (Singer and Beattie in press).

Habitat Modification Effects of Roads

Vegetative disturbances associated with road construction have received less attention in the literature than the avoidance issue. Zager (1980ab) and Jonkel et. al. (1981) noted that road building could disrupt ground and surface water hydrology. Reseeding to present erosion may result in a substantial increase in forage (Nagy and Russell 1978, Ruediger and Mealey 1978) In Denali National Park, snow removal, road dust and modified drainage patterns along roads cause roadside vegetation to green-up somewhat before other areas. Hastened phenology of several favored forage species attracts grizzlies to road areas in late spring (Tracy 1977). Unfortunately, any advantages accrued from the additional foraging opportunities along roads are likely to be outweighed by the undesirable increase in bear-human encounters.

AIRCRAFT IMPACTS

Numerous studies have documented the reactions of grizzly bears to aircraft disturbance. Quimby (1974) found that 67% of the grizzly bears in the Canning River drainage of northern Alaska reacted strongly to both fixed-wing aircraft and helicopters. Thirty-two were already fleeing when first spotted from the aircraft including 1 at 1.0 mile away and several at 0.5 miles. Eighteen percent of these bears ran a short distance and stopped. Klein (1974) found that grizzly bears reacted more severely to all types of aircraft than did ungulate species. Generally, there are 2 types of impacts. These are:

1. Possible displacement and/or disruption of normal behavior patterns (including denning, movements and habitat use) due to aircraft disturbance.
2. Physiological arousal without overt behavioral response.

Helicopter Disturbance

Grizzlies may be more sensitive to helicopter disturbance than to fixed-wing aircraft. In the Canning River study (Quimby 1974), 90% of the grizzlies reacted moderately or strongly to helicopters while only 21% reacted strongly to fixed-wing aircraft. All of the most severe reactions were to helicopters. Grizzly bears on Richards Island, Northwest Territories, also reacted more strongly to helicopters than to fixed-wing aircraft (Harding and Nagy 1980). Bears showed a strong response (fled to cover) 61 and 88% of the time to fixed wing aircraft and helicopters, respectively.

Helicopters had been used in both of the above study areas to pursue and tranquilize grizzlies. Researchers in several areas found that grizzlies which had previously been captured or relocated using helicopters were particularly sensitive to helicopter disturbance (Harding and Nagy 1980, Eebhart 1983, Spreadbury 1984, Harding and Nagy 1980). However, grizzlies in some areas where helicopters had not been employed for this purpose also showed strong reactions (Hamer et al. 1979, Kendall 1985). In the Apgar area of Glacier National Park, 81% of the grizzlies displayed a strong reaction to an approaching helicopter despite the fact that scenic helicopter tour flights had been conducted in the area for several years (Kendall 1984b,1985). Individual bears in several areas demonstrated significantly different tolerances to helicopter disturbance (Lindermann 1974, Aune et al. 1984, McLellan and Mace 1984).

Fixed-Wing Aircraft Disturbances

Some grizzlies also showed strong escape reactions to fixed-wing aircraft. In Yellowstone National Park, both Graham (1978) and Peacock (1978) observed grizzlies which fled into timber as research tracking planes approached. Conversely, Schleyer (1980) reported that grizzlies which he radiotracked in Yellowstone were not disturbed by the research plane while they were in daybeds. Smith and Van Daele (1984) felt that use of small aircraft to spot schools of fish for commercial herring fisheries may have disrupted bear feeding in intertidal areas of Terror Bay, Alaska. McCourt et al. (1984) reported that grizzlies were more sensitive to disturbance by small fixed-wing aircraft than either caribou or moose. However, Campbell (1985) observed that 54.5% of the grizzlies seen from a small plane showed no response while only 29% showed a severe response. McLellan and Mace (1985) similarly found that 15 of 20 grizzlies observed from the air showed no reaction to the aircraft; the remaining 5 ran to cover.

Factors Influencing Grizzly Bear Reactions to Aircraft

Many researchers emphasized the wide variability in grizzly bear reactions to aircraft. Factors which may be important include the degree of habituation to aircraft (Harding and Nagy 1980, Gebhart 1982, Reynolds et al. 1984, Kendall 1985); availability of cover (Klein 1974, Lindermann 1974, Aune et al. 1984, Spreadbury 1984) and altitude, noise level and behavior of the aircraft (Lindermann 1974, McLellan and Mace 1980, Gebhart 1982, Reynolds et al. 1984). McCourt et al. (1974) found that there was no consistent trend in grizzly bear reaction to fixed-wing aircraft at different altitudes.

Grizzly bear relocation data in the Copper River Delta of southern Alaska indicated a relationship between age/sex class of grizzlies and their reaction to fixed-wing aircraft (Campbell 1985). Lone or paired adults seldom reacted

severely while females with cubs were more susceptible to disturbance. However, some females with cubs in other areas appeared to be somewhat habituated to aircraft disturbance (Gebhart 1982, McLellan and Mace 1985).

A bear's pre-disturbance activity may also influence its reaction to aircraft disturbance. Grizzlies may be reluctant to flee from aircraft when feeding on carcasses (Quimby 1974, Rutton 1974) or while at feeding sites (McLellan and Mace 1985).

Reynolds et al. (1984) monitored the heart rates of denning and active grizzlies during aircraft over-flights. Midwinter flights caused no significant increase in heartrate of denning bears. However, during the period just after emergence, the heartrates of 2 different sows increased up to 10 bpm or became erratic when planes flew overhead. Later in the summer, this reaction tapered off. The researchers found that the maximum increase of 22 bpm was not associated with any overt behavioral changes. Although no dens were abandoned due to aircraft overflights in their study area, however, Quimby (1974) reported that 5 bears abandoned den construction due to helicopter disturbance.

GARBAGE IMPACTS

Use of Garbage

Management philosophies regarding the grizzly bear in the national parks of the U.S. and Canada underwent a renaissance in the late 1960s and early 1970s. Prior to that time, grizzlies were often closely associated with garbage in many of these preserves.

Schullery (1980) chronicled the history of the grizzly bear/garbage situation in Yellowstone National Park. Both grizzly and black bears were feeding at hotel dumps as early as the 1890s and "nuisance bears" had emerged by the early 1900s. The number of grizzlies feeding at dumps rose drastically during the early part of this century. Censuses conducted at the dumps indicated 40 grizzlies in 1920 and 260 in 1930 (Schullery 1980). The consequences of the bear-garbage association were recognized long before the issue generated intense public controversy in the early 1970s. In 1913, a representative of the U.S. Geological Survey studying sanitation procedures in Yellowstone recommended that all dumps be fenced to exclude bears. In 1932, a report prepared by the Branch of Research and Education suggested that the dumps were unhealthy for the bears and no longer necessary in Yellowstone. Two "feeding grounds" at Old Faithful and Canyon Village, were maintained for public viewing of the bears until 1935 and 1942, respectively. Prior to closure, up to 70 grizzly bears could be observed at the Canyon Village public feeding area on a single night (Schullery 1980). Murie (1944) conducted the first legitimate scientific study of the grizzly bears in Yellowstone. Following his first field season, he concluded that:

> "Some such contrivance for keeping bears out of garbage cans is the most important recommendation I can make as a result of my observations last summer."

The high attraction of garbage dumps to grizzly bears was evident from the movement patterns of Yellowstone grizzlies as documented by the Craighead study from 1959-1970. Individual bears moved up to 86 km from marking sites at the dumps to subsequent relocations or death in national forests adjacent to the park (Craighead 1980, Craighead and Mitchell 1982). Ratios of marked to unmarked grizzlies in various areas yielded estimates of from 56 to 77% as the proportion of the total Yellowstone population which congregated at the dumps (Cowan et al. 1974, Craighead et al. 1974 McCullough 1981). These concentrations of grizzly bears were likened to the "natural" concentrations of grizzlies at other dependable sources of high-calorie foods such as salmon spawning runs (Craighead and Mitchell 1982). Hornocker (1962) discussed the complex social dynamics which developed at these dump aggregations.

The last of the open pit garbage dumps inside Yellowstone National Park was closed in 1970. The controversy surrounding closure of the Yellowstone dumps is beyond the scope of this report. Detailed accounts are available elsewhere (Cole 1973, Craighead 1979, Schullery 1980, Meagher and Phillips 1983). Garbage was still available to grizzlies in municipal dumps near the park until the late 1970s (Greer 1976b, 1979; Schullery 1980, Knight et al. 1981).

Yellowstone was not the only North American park to experience problems with garbage and bears. Martinka (1971) felt that declining injury rates in Glacier National Park, Montana, during the 1960s were related to decreased availability of unnatural foods along with greater emphasis on preventative control policies. Open-pit garbage dumps and poorly designed incinerators enabled grizzly bears to obtain garbage in several Canadian national parks throughout the 1960s (Mundy and Flook 1973, Kaye 1982). The landfills in Banff and Jasper National Parks were fenced in 1970 but habitual "garbage bears" still managed to obtain garbage by digging under, or breaking through, the enclosures (Kaye 1982). The Banff landfill was closed in 1980 and an electric fence was placed around the Jasper landfill in 1981 to discourage bear activity. Kootenay and Yoho National Parks have hauled all refuse to nearby communities since 1973 and 1974, respectively (Kaye 1982).

Dean (1978) documented problems with grizzly bears and garbage in Katmai National Monument, Alaska. In some cases, garbage cans were used to bait bears for photographs. Downing (1975) observed 17 different grizzly bears feeding in the Denali National Park landfill in 1974. This dump was fenced and an electric line was installed in 1976-77 (Singer 1982, Van Horn and Dalle-Molle 1984). Prior to being fenced, 10-25 grizzlies fed in the dump each year (Singer 1982). Beginning in 1980, all refuse from Denali was hauled to the public landfill in Nenana. Singer (1982) felt that closure of the park dump, bear-proofing of most garbage cans and increased visitor awareness were the primary factors in minimizing grizzly bear incidents in Denali. However, poor garbage handling practices by the park concessionaire enabled bears to acquire garbage at least until 1984 and some garbage-related bear incidents persisted (Van Horn and Dalle Molle 1984).

Although progressive management programs to isolate bears from garbage have been implemented in most Canadian and American national parks, garbage handling practices have caused persistent problems in towns bordering Yellowstone National Park (Knight et al. 1982). Hunt (1982) observed grizzlies using the West Glacier dumpster site by Glacier National Park, Montana. Hoak and Clark

(1979) found that garbage handling was inadequate in 14 of 36 outfitter camps which they examined in the Bridger-Teton National Forest (YGBE). Improper handling of garbage was a "constant" problem during construction of the Northwest Alaskan Pipeline Project (Follmann et al. 1980). In brief, any activity which brings humans into bear country, whether recreational, industrial or residential, can potentially allow grizzlies access to garbage if proper sanitation procedures are not followed. Impacts from garbage generally fall into 4 categories:

1. Attraction of bears to human developments or activity.
2. Effects on bear behavior toward humans, in particular habituation to human scent or association of human stimuli with a food reward.
3. Effects on intraspecific behavior due to congregations at garbage dumps.
4. Effects on nutritional status and, secondarily, on reproductive parameters of a grizzly bear population.

Impacts of Garbage Feeding

The foregoing discussion merely establishes that grizzlies have had, and in many instances continue to have, access to garbage. That this association was undesirable for both bears and humans has long been appreciated (Murie 1944), but only recently has a systematic study of the topic been undertaken.

Herrero (1970, 1976, 1978a, 1982, 1985) and others analyzed the circumstances behind grizzly bear inflicted injuries to humans. He concluded that bears which habitually fed on human food and garbage often lost their natural wariness of people. Such "food conditioned" bears were more likely to show aggressive tendencies than non-food-conditioned bears (Herrero 1970, 1976, 1985). Herrero (1970) postulated that although grizzlies which fed on garbage in dumps did not necessarily become conditioned to human scent, these bears might be more readily drawn to food in developed areas where a firm association of humans with food would be established. J.J. Craighead and F.C. Craighead, Jr. (1972) found that the greater tolerance to man which grizzlies showed while feeding at the dumps was not observed when these same bears were encountered in the backcountry 0.5 miles or more from the dump sites.

Although there is some uncertainty as to the degree of habituation/conditioning related solely to feeding at remote garbage dumps, there is general agreement that acquisition of garbage or other human foods in campgrounds or developed areas can have serious consequences (Herrero 1970, J.J. Craighead and F.C. Craighead, Jr. 1972). McCullough (1982) applied the principles of behavioral learning theory to the bear-garbage issue. He observed that once a bear had been positively conditioned by food rewards from human sources, it might seek food in response to any of the broad stimuli (i.e., human scent, human presence, human structures and equipment) associated with prior successful procurement of food even when no food was detected.

Regardless of the exact scenario leading to an encounter, the evidence linking food conditioned grizzly bears to human injury is persuasive. Within the North American national parks, habituated, food-conditioned grizzlies accounted for approximately two thirds of all bear-inflicted human injuries up to 1970 (Herrero 1976, 1985). Ninety percent of these injuries occurred in developed campgrounds in Yellowstone National Park where grizzlies had a long history of feeding on human refuse. Since 1970 (when many national parks initiated new programs for garbage management), improperly stored food and garbage was the second most common circumstance, following surprise encounters, associated with grizzly bear inflicted injuries (Herrero 1982). The peak human injury rate in Yellowstone National Park occurred in the 1960s when an average of 3.6 and 0.3 injuries occurred each year in developed and backcountry areas, respectively (Cole 1973). This was also the period of greatest use of garbage dumps by grizzly bears. The Craighead study team documented up to 137 individuals feeding at dumps in a single evening (Craighead and Mitchell 1982).

Seven of 9 deaths inflicted by grizzlies in Yellowstone and Glacier National parks between 1967 and 1984 were by garbage habituated bears. One of the other 2 deaths (Lawrence Gordon, Glacier National Park, September 1980) was due to a human-habituated grizzly without a known history of garbage feeding. The bear responsible for the most recent death (Brigitta Frendenhagen, Yellowstone National Park, July 1984) was not identified although circumstantial evidence suggested that the grizzly was a subadult having some prior experience with human activities. Likewise, the grizzly bear which killed 1 man and mauled 3 others in Banff National Park in 1980 had been previously feeding on garbage on the edge of Banff townsite (Herrero 1985).

Only a very small fraction of the grizzly bears which have a history of garbage feeding are ever involved in human injuries (Herrero 1982). However, garbage-feeding bears may be predisposed to other infractions requiring control actions and potential loss to the population. The number of grizzly bear control actions in Yellowstone National Park escalated dramatically following closure of the last open pit dump in 1970. Thirty grizzlies were translocated and 12 were destroyed during that year (Meagher and Phillips 1983). An earlier peak in control actions occurred in 1942 when closure of the Canyon Village dump combined with a poor food year resulted in 28 grizzlies being killed for control (Schullery 1980). Comparisons of control actions from one period to another must be viewed cautiously as management philosophies are subject to change (e.g., Cole 1976). A shortage of natural foods in 1981 also created grizzly bear problems in the Yellowstone ecosystem. During that year, 23 grizzly bears were trapped and relocated 33 times by management agencies. Nearly all grizzly bear complaints during 1981 were related to the availability of human food and garbage (Knight et al. 1982).

During construction of the Northwest Alaskan pipeline from 1971-1979, 12 grizzly bears were translocated and 13 were killed for control actions. Sixty-seven of 85 reported grizzly bear incidents involved bears in camp dumps or bears feeding on garbage or handouts (Follmann et al. 1980).

Effects of Garbage Feeding on Grizzly Bear Weight and Reproduction

The nutritional value of garbage and its influence on grizzly population biology has been examined in several studies. Rogers (1976) reported that black bear females that lived near large garbage dumps tended to produce larger litters or have higher cub survival than females which did not feed on garbage. In Yellowstone National Park, the average size of grizzly bear litters before closure of the dumps (1959-70) was 2.1 cubs whereas the average litter size after dump closure (1974-82) was 1.9 cubs. Age of first reproduction also declined between the 2 periods. From 1959-70, 70% of the females first reproduced at age 5 while from 1974-82, 60% produced their first litters at age 6 (Knight and Eberhardt 1984, 1985). Whether this variation in reproductive rate was actually due to dump closure has been debated in the literature. Picton (1978, in press) found a high correlation between climatic variation and grizzly bear litter size in Yellowstone. Other researchers found that cub recruitment was highly correlated with the number of adult males in the population (McCollough 1981, Stringham 1983, in press a).

Knight et al. (1981) found that 3 adult males which frequented the Cook City dumps weighed less when recaptured in 1980 after the dump was closed than when initially captured in 1975-79. The mean weight of male bears 5 years and older was significantly less after dump closure (Knight et al. 1981). Russell et al. (1979) observed that the only monitored grizzly in Jasper National Park which used a major landfill was exceptionally large for his age. Their observations, though limited, suggest that bears which used garbage to supplement their natural diet did attain greater weights than bears without this subsidy.

RECREATIONAL IMPACTS

A number of recent studies have addressed the impacts of recreational activities on grizzly bear behavior, habitat use and survival. The effects of motorized recreation on grizzlies were discussed in the previous section on road impacts and will not be reported here.

Recreational developments are often situated within, or adjacent to, high quality bear habitat and recreational activity often concentrates people in areas of high grizzly bear use (B.I.A. 1981, Servheen 1981). High elevation areas provide both panoramic vistas and grizzly bear foods while lower elevation streambottoms or sparsely timbered ridges serve as easy travel corridors for both bears and people (Tirmenstein 1983).

Correlations between increased visitor use of designated recreational areas and grizzly bear problems have been noted in several areas (e.g., Noble 1972, Faro and Eide 1974, Mundy and Flook 1973, Martinka 1982a). In Denali National Park, Alaska, bear incidents were very uncommon prior to the opening of the park highway in 1972 and the resultant influx of visitors. Both frontcountry and backcountry incidents increased greatly during the 1976-78 period. Bear incidents were significantly correlated to the total visitation in backcountry units, with 58% of the backcountry incidents relating to a food incentive (Sizemore 1982). Similarly, Martinka (1982a) reported that in Glacier National Park, Montana, the number of bear confrontations appeared to be closely correlated with park visitation for the 1951-80 period.

Researchers in Denali noted that bear encounters could be expected to occur each year because campgrounds were located near prime bear habitat or along travel routes (Van Horn and Dalle-Molle 1984). Bear managers in other major park units have made similar observations. In Katmai National Monument, man-made facilities at Brooks River Camp interfere with the normal movements of bears fishing along the Brooks River and bring bears and humans into close proximity (Dean 1968, Troyer 1980a, Beattie 1983). A comparable situation exists at the Fishing Bridge development in Yellowstone National Park; primary roads and developments were situated within the most productive spring bear habitat. Concern about the impact on grizzly bears from expanding recreational use of productive bear habitat has been expressed for numerous other areas (e.g., Noble 1972, B.I.A. 1981, Post 1982, McCory and Herrero 1983b, McCrory et al. 1986).

Mortality Relating to Recreational Activity

The consequences of superimposing high recreational activity on productive grizzly bear habitat include both direct mortality and reduced habitat effectiveness. Miller and Chihuly (in press) recently analyzed the causes of non-sport grizzly bear deaths in Alaska. They found that 31.3% of these mortalities were caused by hunters, most (87%) of whom perceived the bear as an immediate or potential threat to their life or property. Another 8.1% of the non-sport mortalities involved individuals who were sport fishing or hiking. Gunson (1985) evaluated grizzly bear mortalities in Alberta for the 1972-84 period and found 12 cases of mistaken identity deaths (grizzlies mistaken for black bears), 24 cases of self-defense killings by hunters and 4 cases of problem bears killed in recreational or tourist camps. Problems involving grizzly bears attracted to hunter camps or causing other hunter related problems are also common in the conterminous states (e.g., Greer 1982, Roop 1982,1983). The special consideration of grizzly bears being mistaken for black bears by hunters of the latter species is discussed in a subsequent section.

Mattson et al. (in press b) studied the impacts of developments and primary roads on grizzly bears in Yellowstone National Park. They found that adult bears which were relocated most often within a 0-3 km zone around developments had twice the risk of mortality as adults in more remote areas. The mortality risk was nearly 5 times greater for females in the inner zone but only marginally greater for adult males. Conversely, subadults suffered their greatest mortality risk in zones furthest from developments. These results suggested that the subadults were either displaced by adult bears into the less secure zones adjacent to developments (as indicated by a model representation of subadults in the 0-3 and 3-9 km zones around developments) or stood an increased mortality risk by co-occupying the more remote zones with adult bears.

High adult female mortality risk close to developments was believed to be a consequence of habituation to predictable high density human presence. Subadults and adult males occupying the inner zone were presumably "neutral" (i.e., indifferent to human presence or developments but not

actively seeking human foods) rather than habituated (seeking out human-related foods). Thus, these classes of bears were less predisposed toward conflict situations than were the habituated adult bears.

Displacement and/or Reduced Habitat Effectiveness for Nonmotorized Recreational Activity

Several recent studies have specifically addressed impacts of recreational activity on grizzly bear habitat use and activity patterns. The most intensive work has been conducted in Yellowstone National Park.

Schleyer et al. (1984) studied the effects of nonmotorized recreational activity on grizzly bear behavior and habitat use in Yellowstone. Bears were monitored for 24 hours before a simulated disturbance (an approach on foot or erection of a campsite) was initiated. They found that human activity in wilderness habitat did affect the habitat use, activity patterns and behavior of grizzly bears. Six of 7 planned disturbances, and 3 incidential disturbances, caused immediate and rapid displacement of the studied bears. During the predisturbance phase, the bears' probability of activity averaged 56%, while during the immediate (0-2 hour) post-disturbance phase, the probability of activity rose to 78%. During the 2 24-hour post-disturbance period, the disturbed bears' average range length, average total daily movement and average net daily movement exceeded that of undisturbed bears.

Disturbances also resulted in bears using less suitable habitat. Tested bears spent more time in dense timber further from natural openings and perennial water. They also used higher elevation, less gentle terrain and locations remote from human travel more often than did non-disturbed bears. Two of the tested bears were less sensitive to disturbance than the others. Their diminished reaction was attributed to 2 different factors; habituation for 1 and residence within a preferred foraging area (elk calving ground) by the other.

Haroldson and Mattson (1985) reported results from the second year of the Yellowstone recreation study. They noted that the earlier study (Schleyer et al. 1984, discussed above) tested bears' responses to recreational activity in improbable settings, collected no long duration post-disturbance data and failed to give adequate consideration to the study bears' individual character and the unique episode conditions. In this study, Haroldson and Mattson (1985) tested the response of 3 radioed bears to simulated recreationsl activity by monitoring their response for 36 hours before and after they were approached at 100-400 m. Four episodes were executed as planned. Responses varied greatly by individual bear and only 1 of the 3 adult females tested exhibited a long duration response to the study's most flagrant impingement.

The researchers constructed a conceptual model to describe the factors contributing to a bears' immediate and long duration response to recreational activity. Four factors (cultural background, status, physiological state and foraging strategy) conditioned bears for a repertoire or "syndrome" which elicited a specific response according to the particular setting and level of human presence. The spatial-temporal predictability and level of human use were probably significant factors determining the level of a bears' response to "accumulated" backcountry use. The researchers concluded that Yellowstone grizzly bears were likely to experience longer duration disturbance effects than were indicated by their results since much of the Yellowstone backcountry received greater sustained, predictable recreational use than was simulated by their tests. Responses were likely to be greater for the least habituated or neutral bears and in open or productive habitats.

Gunther (1984a) and Gunther and Renkin (1985) studied the effects of backcountry recreational activity on grizzly bear use of Pelican Valley adjacent to the Fishing Bridge development in Yellowstone National Park. Of special interest was the response of grizzlies to seasonal closures of the valley to human use. The researchers found a significant difference in the number of bear sightings during the closed and open periods with a significant inverse relationship between the number of bears per day and the number of people per day (versus the average number of parties per day). The number of bear sightings within 0.4 - 0.8 km (0.25 - 0.50 miles) of backcountry campsites was dependent upon site occupancy. Fewer bears were observed near campsites when they were occupied by people. Some effects on bear habitat use was also noted. Bears were observed significantly closer to cover during the open periods than during the closed periods. (The relationship between plant phenological changes and numbers of grizzlies using the Pelican Valley was not addressed in this study.)

These findings correlated well with the results of an earlier study on the relationships between angler and bear use in the Clear Creek and Cub Creek drainages east of Yellowstone Lake (Gunther 1984b). That study indicated that in years with the highest spawning run, the number of anglers peaked but the bear fishing activity was lowest. After an area closure was initiated in 1983, the angler use reached its lowest and the bear use its highest level in 7 years.

Few other systematic studies of the impacts of nonmotorized recreation on grizzly bears have been conducted. McLellan and Mace (1984) reported that people travelling on foot in areas more than 500 m from a primary or secondary road resulted in strong flight responses from their study bears. People walking on primary or secondary roads or at a residence elicited a more moderate response. Schallenberger and Jonkel (1979a, 1980) measured the distance of grizzly bear relocations in the Rocky Mountain East Front to hiking trails of various use levels. They found that bears tended to be closer to low and moderately used trails than to trails receiving high or extremely high use. They noted that this result could be due to either disturbance factors or to the relative densities of the different trail types. Kasworm (1985) reported that in the Cabinet Mountains of northwestern Montana, the annual mean distances of grizzly bear relocations to roads and trails were 2467 m and 821 m, respectively.

Impacts of Recreational Developments

Mattson et al. (in press b) evaluated the impacts of primary roads and developments on grizzly bears in Yellowstone. They found that in zones beyond the conceivable influence of human emplacements, grizzly bears occupied habitat which was more productive than the average for that zone. However, in zones proximal to roads and developments, grizzlies occupied habitat which was close to, or

below, the average for that zone. Thus, it appeared that grizzly bear foraging strategies directed towards habitat optimization were disrupted by human emplacements. Around developments, this disruption was evident out to 3.5 km in spring and summer (less in fall). Around roads, habitat use was influenced out to 2.5 km in spring and summer and 4.0 km in fall.

Mattson et al. (in press b) also evaluated the displacement effects of human developments. They found that adult bears showed a bimodal distribution with neutral/habituated bears occupying the 0-3 km zone around developments and a group of more wary adults occupying the 9-15 km zone. All of the young adults in the study occupied the 9-15 km zone, while subadults were more often occupants of the 0-3 and 3-9 km zones. Possible explanations for the observed subadult distribution were discussed previously.

Overall, roads tended to reduce grizzly bear use to a "micro" scale (0-1500 m) while developments did not. However, the concentrated human activity at developments had a much greater "micro" scale (0-15 km) effect on grizzly bear occupancy and use of habitat than did roads. This was attributed to the greater human density and persistently high levels of human activity into the nocturnal hours around developments. The researchers calculated that up to 15.7% of the available habitat production in Yellowstone was not used by adult females during summer because of primary road and development effects.

The impact on grizzly bears by recreational activity and development in the Fishing Bridge/Pelican Valley area of Yellowstone National Park has received considerable attention in recent years. Controversy has arisen surrounding the proposed removal of all recreational facilities and increased regulation of backcountry human use around the Fishing Bridge area (Knight et al. 1984a, NPS 1984d).

The Fishing Bridge area has been used by tourists since the early days of the park. As of 1984, it continued to receive intensive human use in the form of day use, overnight backcountry hiking, angling, camping (2 established frontcountry campgrounds) and horse use (NPS 1984d) (Note: Some of the activities have been, or are scheduled, to be discontinued). Visitor cabins were retired from use in 1975.

Habitat analysis of the development area indicated that it was better-than-average grizzly bear habitat relative to the rest of Yellowstone National Park. It ranked high for vegetative diversity and was ecologically more diverse than any other developed area in the park. The development also lies adjacent to 2 of the most critical spawning areas for Yellowstone cutthroat trout, an important food source for grizzly bears (Knight et al. 1984a, NPS 1985d).

The unique status of Fishing Bridge as the only major development to lie within superior grizzly bear habitat was reflected in the number of injuries, control actions and bear mortalities that have occurred in the area. Fishing Bridge accounted for more than 50% of all grizzly bear injuries in Yellowstone National Park from 1968-83. Injury rates declined after 1977, but this decline may have been due to displacement of bears by increasing numbers of visitors. The annual number of bear observations at Fishing Bridge dropped abruptly after 1977 suggesting that bears had reached a threshold of tolerance for visitor numbers in the area (Knight et al. 1984, NPS 1984d). The Fishing Bridge area also led the park in number of bear removals (control kills, accidential kills and removal from the ecosystem) for the 1968-83 period. Although management actions declined parkwide from 1968-83, the proportion of control actions occurring at Fishing Bridge increased dramatically (NPS 1984d).

Impacts of Recreational Activity on Bear Behavior: Habituation

Habituation may be defined as a long-term decrease in the frequency or magnitude of a response as a result of a repeated stimulation (Jope 1982). Indications of grizzly bear habituation to human stimuli have been noted for several areas (e.g., Jope 1982, 1983a, 1985, Haroldson and Mattson 1985, Mattson et al. in press b).

The effect of recreational activity on grizzly bear habituation was originally discussed by Jope (1982, 1983a, 1985) with reference to grizzly bear behavior in Glacier National Park, Montana. Factors which contributed to bear habituation were a consistent context for encounters with hikers (such as along trails); frequent, irregularly spaced, encounters; easily recognized stimuli (such as hikers with bear bells); and, innocuous behavior by the hikers (Jope 1985). Jope theorized that by reducing the occurrence of "full" charges, habituation of grizzly bears' fear response actually reduced the rate of injury to hikers from surprise encounters with adult and subadult grizzlies. She noted (Jope 1982) that no recorded hiker injuries had involved a bear that appeared to be habituated.

Keating (1983) further examined the trends in grizzly bear numbers and behavior (1910-1980) relative to sightings and confrontation rates in Glacier National Park. His analysis supported Jope's (1982) observation that habituated behavior resulted in fewer confrontations per encounter. Data showed that the number of confrontations per encounter (visual contact with 1 or more grizzlies) declined exponentially at about 9% annually. However, confrontation rates continued to increase exponentially (about 5% annually) despite that trend. Thus, the total number of encounters (a function in increases in both visitation and grizzly population size) was greater than the habituation-related decline in the number of confrontations per encounter.

Kendall (in press) also studied the trends in encounter and confrontation rates in Glacier National Park. Several trends appeared to be related to the habituation behavior described by Jope (1982, 1983a, 1985). Kendall found that "approach" encounters had increased during the last 7 years and were most prevalent in areas of high visitor use. This was due either to increased visitation which brought more people into contact with habituated bears or an increase in the number of habituated bears. Kendall also found that the number of grizzly bear incidents occurring around high visitor use areas was lower than expected from the amount of visitor use these areas received. There was also a lower frequency of camper incidents in high use areas than predicted by camper distribution. Both of these findings suggested that the increased exposure to humans by grizzly bears in these areas resulted in more habituated bears or, alternatively, that management practices may have mitigated some of the expected bear problems. Kendall noted that habituation might also have deleterious

consequences in that loss of the usual avoidance response could lead to more grizzly bear/camper encounters.

Warner (in press) observed what appeared to be habituated behavior by some bears at the Pack Creek brown bear reserve on Admiralty Island. She found that brown bears using the reserve area were more diurnal than those in the nearby control area. She attributed this to possible habituation of the less wary bears.

Haroldson and Mattson (1985) reported that most grizzly bears in Yellowstone could logically be placed into 1 of 3 categories according to their reaction to human presence and developments. "Wary" bears were those which characteristically fled from human encounters and avoided development areas. "Neutral" bears were those indifferent to human presence or developments but not actively seeking human foods. "Habituated" bears were those which tended to actively search out human-related foods. The findings of Mattson et al. (in press b) relating to habituated grizzlies in development areas were discussed previously. It should be noted that the definition of habituation applied in these 2 studies differs somewhat from the definition employed by Jope (1982, 1983a, 1985).

Impacts of Winter Recreation Activities and Developments

Literature pertaining to the impacts of winter recreation sites and snowmobile activity on grizzly bears was very limited. Madel (1983) evaluated the potential impacts of a proposed ski development in northwestern Montana. He concluded that the development could potentially influence bear use of the area by reducing the amount of secure, undisturbed habitat to a level below that necessary for normal nutritional and behavioral needs, displacing bears from important seasonal habitat components during critical use areas, causing permanent loss of seasonal habitat and increasing the possibility of undesirable grizzly bear/human interactions. Hadden and Jonkel (1983) reported that the most deleterious effects of another proposed northern Montana ski development would result from the habitat alterations and increased potential for human activity in the non-ski seasons. McCrory and Herrero (1983b) noted that the increased recreational use around Mt. Allan (site of the 1988 Olympic downhill skiing events) would result in increased possiblilites of bear/human encounters.

Mealey (1976) evaluated the habitat characteristics and potential impacts on grizzly bears from the proposed Ski Yellowstone development west of Yellowstone Park. His analysis of late spring/early summer food and cover values indicated that the area was generally low-quality grizzly habitat. He therefore concluded that negative impacts from the ski facilities and adjoining resort community would be minimal.

A subsequent review of the Ski Yellowstone development by Knight and Blanchard (1984) reached different conclusions about the probable impacts of the project. Their analysis was based primarily on data collected by the Interagency Grizzly Bear Study Team and an intensive study of the development area by Blanchard (1978). They concluded that the Ski Yellowstone development had the potential of becoming a major population sink for the Yellowstone ecosystem grizzly population. From 1973-83, home ranges of 7 collared grizzlies encompassed the project area. Final dispositon of the Ski Yellowstone proposal by the U.S. Forest Service is currently pending as the agency completes a cummulative effects analysis of the project as per Weaver et al. (1986).

Impacts on grizzly bears from snowmobile activity are largely unknown. Jonkel (1980b) reported that 1 grizzly bear den was abandoned after snowmobile disturbance and another after foot disturbance. Reid et al. (1983) evaluated the effects of the proposed Clark Fork snowmobile corridor on grizzly bears. As with the ski area developments noted above, they felt that the most serious consequences of the corridor development were off-season uses. The potential for displacement and stress caused by 2-wheeled vehicular traffic was of greatest concern, especially in the late fall and early spring.

GRIZZLY BEAR-BLACK BEAR RELATIONSHIPS

Herrero (1978b, 1979) compared the evolutionary adaptations of grizzlies with black bears. He noted that while the 2 species are capable of coexisting in some forest ecosystems, the grizzly is better adapted for exploiting more open habitats. The grizzly's larger body size (1.5:1 to 2.0:1 for same sex and age class) and more aggressive nature generally give it an advantage in open areas. Several studies in northern and northwestern Montana likewise found that grizzlies predominated in open shrub and burn areas (Jonkel and Cowan 1971, Shaffer 1971, Martinka 1972, Kasworm 1983). The grizzly is better adapted than the black bear for extracting food from the soil (Herrero 1979) and small mammals comprise a greater portion of the grizzly's diet than the black's (Jonkel and Cowan 1971, Shaffer 1971, Martinka 1972). Comprehensive food habit comparisons for the 2 species were not available.

Where grizzly bears and black bears occur sympatrically, temporal isolation may help prevent direct competition. In the Apgar Mountains of Glacier National Park, grizzlies appeared to displace black bears from preferred huckleberry foraging sites during peak availability. Later in the season, grizzlies abandoned these patches and black bears moved in (Kendall 1984b, 1985, Peacock 1978). In an earlier study in the same area, Shaffer (1971) observed that when both species were foraging in medium and low elevation huckleberry stands, grizzlies had priority during twilight and night while blacks foraged more often during the day. Jorgensen (1979) reviewed the literature on activity patterns of black bears and grizzly bears and concluded that in the Targhee National Forest (YGBE) limited overlap in peak activity patterns probably prevented most aggressive encounters between the 2 species. Trapping data reinforced the temporal segregation hypothesis for blacks and grizzlies in the Yellowstone region (Schleyer 1983).

Grizzly Bear-Black Bear Encounters

Barnes and Bray (1967) analyzed 49 encounters between grizzly and black bears at Yellowstone National Park garbage dumps. Black bears were submissive in 40.8% of the encounters and dominant in 28.6%. The 2 species were mutually tolerant in 15% of the enounters. Mortality of

black bears from grizzly attacks has been documented in several areas (Arnold 1930, Hornocker 1962, Jonkel and Cowan 1971, Murie 1981). Some of the aggressive encounters involved adult grizzlies killing, or attempting to kill, black bear cubs (Miller 1985b). Murie (1981) witnessed 1 exceptional case in which a lone grizzly happened upon a black bear sow with 2 cubs. After quickly killing both cubs the grizzly moved a short distance and continued grazing. In other cases, black bear sows with cubs have mounted successful defenses against adult grizzlies (Mundy and Flook 1970, Miller 1985b).

Grizzly Bear-Black Bear Population Relationships

Some interesting relationships between black and grizzly bear population densities have been detected in several areas. Jonkel and Miller (1970) noted that as local grizzly populations declined west of Hudon Bay, black bears extended their range into barren-ground habitats. Similarly, as human encroachment and habitat disturbances increased in the Swan Hills region of Alberta, black bear densities increased while grizzly bear densities declined (Nagy and Russell 1978).

In the North Fork of the Flathead Valley, grizzlies were predominant toward the northern end while black bears were predominant toward the southern end (Jonkel 1984b). Comparing densities for 2 consecutive years, Jonkel (1984b) noted that a drought in 1 year may have forced grizzlies into bottomland areas where black bears were common the previous year, resulting in a much reduced black bear density due to displacement or killing by grizzlies. The overall disparity from north to south may have been due to a habitat gradient (more open, burned, areas in the north), human pressure on the grizzly population or the competitive advantage of an established high density population of black bears in the south and grizzlies in the north.

The above studies indicate that although interspecific conflict may prevent the black bear from making significant inroads into habitats and areas with flourishing grizzly populations, black bear dendties may rise if the grizzly population is suppressed by some other factor (especially human activity). The higher reproductive rate, smaller home range and greater adaptibility to human presence give the black bear some selective advantage under certain circumstances (Herrero 1978b, Nagy and Russell 1978). In areas with existing high densities of black bears, expansion of grizzly populations may be partially due to competitive exclusion of subadult grizzlies (Jonkel 1984b).

Mistaking Black and Grizzly Bears

One aspect of the grizzly-black bear relationship which has received increased attention recently is the "look-alike" hunting problem. Black bear hunters sometimes mistakenly harvest a grizzly bear. In Montana, 10 grizzly bear mortalities fell into this category from 1975-1984, 4 in 1983 alone (Dood et al. 1985). In Wyoming, 9 mistaken identity mortalities occurred from 1982-1984 (Roop pers. commun. in Dood et al. 1985).

GRIZZLY BEAR-WOLF RELATIONSHIPS

Most of the literature on grizzly bear-wolf relationships deals with behavior at carcasses. In most of the described encounters, grizzlies either successfully defended a carcass or were able to appropriate carcasses from wolves (Murie 1981, Ballard 1982). Magoun (1976) analyzed 173 observations of grizzly bears and wolves interacting at carcasses in northeastern Alaska. He observed 39 aggressive acts by bears toward wolves and only 1 aggressive act by a wolf. Ballard (1980) described 1 instance in southcentral Alaska when a brown bear apparently displaced a wolf pack from a moose carcass and killed an adult male wolf in the process.

Wolves were not always the losers, however. Ballard (1982) found that wolves managed to tree 3 yearling cubs and in another case a yearling brown bear was apparently killed by wolves. Ballard (1982) found evidence for competitive predation/scavenging by wolves and bears. Encounters between the 2 species were most frequent when prey density was lowest. Carcasses were contested for more often after mid-June when other prey was less available.

GRIZZLY BEARS AND OTHER MAMMALS

Kendall (1981, 1983b) investigated bear use of pine nuts in Yellowstone National Park. She found that grizzly bears compete with red squirrels (and possibley black bears) for whitebark pine nuts by raiding squirrel nut caches in fall and spring. The dynamics of this relationship were of interest because pine nuts are high in food value and provide a nutritious food source when alternate foods are scarce.

Murie (1981) briefly described encounters between grizzly bears and wolverine, fox, golden eagles and corvids. Graham (1978) stated that bison and elk appeared to compete heavily with grizzlies for succulent grasses and forbs. No quantitative data were provided.

MANAGEMENT CONSIDERATIONS

ADMINISTRATIVE MANAGEMENT GUIDELINES

Standardized grizzly management guidelines have been developed for all National Forest, National Park and Bureau of Land Management lands (Mealey 1986). Each management situation classifies a type of land area where unique grizzly populations and habitat conditions exist, and where the management direction applies. Managers are required to identify the different management situations in their areas of responsibility and apply the management directives. The management situation guidelines are presented below (Mealey 1986). A summary of the acreage classified under Management Situations 1-3 are presented in Table 15.

Management Situation 1

Population and Habitat Conditions

The area contains grizzly population centers (areas key to the survival of grizzlies where seasonal or year-long grizzly activity under natural, free-ranging conditions is common) and habitat components needed for the survival and recovery of the species or a segment of its population. The probability is very great that major federal activities or programs may affect (have direct or indirect relationships to the conservation and recovery of) the grizzly.

Management Direction

Grizzly habitat maintenance and improvement and grizzly/human conflict minimization will receive the highest management priority. Management decisions will favor the needs of the grizzly bear when grizzly habitat and other land use values compete. Land uses which can affect grizzlies or their habitat will be made compatible with grizzly needs or such uses will be disallowed or eliminated. Grizzly/human conflicts will be resolved in favor of grizzlies unless the bear involved is determined to be a nuisance. Nuisance bears may be controlled through either relocation or removal, but only if such control would result in a more natural, free-ranging grizzly population and all reasonable measures have been taken to protect the bear or its habitat (including area closures or activity curtailments).

Management Situation 2

Population and Habitat Conditions

The area lacks distinct grizzly population centers; highly suitable habitat does not generally occur, although some grizzly habitat components exist and grizzlies may be present occasionally. Management Situation 2 areas may be necessary for survival and recovery of the species, although the status of such areas is subject to review and change according to demonstrated grizzly population and habitat needs. Major activities or programs may affect the conservation and recovery of the grizzly bear primarily as they may contribute toward human-caused mortalities.

Table 15. Area summary of the Northern Continental Divide and the Greater Yellowstone Grizzly Bear Ecosystems current occupied habitat acres (in thousands).

Administrative Unit	Management Situation 1	Management Situation 2	Management Situation 3	Unstratified	Total
National Park Service					
Yellowstone NP	2219	33	0.2	—	2222.2
Grand Teton and Parkway	95	—	2.4	—	97.8
Glacier NP	1007	—	7	—	1014
Bureau of Land Management	—	3	—	24	27
Indian Reservations	116	107	0	—	392
Private/State	—	—	—	697	697
Forest Service					
Bridger-Teton	666	62	7	—	734
Custer	6	105	—	—	111
Flathead	1694	355	7	—	2056
Gallatin	413	340	1	—	754
Helena	96	84	—	—	180
Kootenai	116	90	0.4	—	207
Lewis and Clark	764	5	7	—	776
Lolo	213	58	—	—	271
Shoshone	412	820	17	9	1249
Targhee	171	217	1	—	389

Management Direction

The grizzly bear is an important, but not the primary use on the area. Habitat maintenance and improvement and grizzly/human conflict minimization may be, in some cases, important, but not the most important, management consideration. Management will at least maintain those habitat conditions which resulted in the area being stratified as Management Sitation 2. Minimization of grizzly/human conflict potential that could lead to human-caused mortality of grizzlies is a high management priority. Demonstrated grizzly populations or grizzly habitat use will be accomodated in other land use activities if feasible, but not to the extent or exclusion of other use needs. A feasible accomodation is one which is compatible with (does not make unobtainable) the major goals or objectives of other uses. When grizzly population or grizzly habitat use and other land use needs are mutually exclusive, the other land use needs may prevail in management considerations. If grizzly population or habitat use represents demonstrated needs that are so great (necessary to the normal needs or survival of the species or a segment of its population) that they should prevail in management considerations, then the area should be reclassified under Management Situation 1. Nuisance grizzlies will be controlled.

Management Situation 3

Population and Habitat Conditions

Grizzly presence is possible but infrequent. Developments, such as campgrounds, resorts or other high human use facilities and human presence result in conditions which make grizzly presence untenable for humans.

Management Direction

Grizzly habitat maintenance and improvement are not management considerations. Grizzly/human conflict minimization is a high priority management consideration. Grizzly bear presence and factors contributing to their presence will be actively discouraged. Any grizzly involved in a grizzly/human or frequenting an area will be controlled.

Management Situation 4

Population and Habitat Conditions

Grizzly bears do not occur in the area but habitat and human conditions make the area potentially suitable, and the area is necessary for the recovery and survival of the species.

Management Direction

The grizzly bear is an important potential use on the area. Habitat maintenance and improvement are important management considerations. Human and habitat conditions will not be degraded by decisions regarding grizzlies.

Management Situation 5

Population and Habitat Characteristics

Grizzly bears do not, or only rarely, occur in the area. Habitat may be unsuitable, unavailable or unoccupied. The area lacks survival and recovery values for the species or said values are unknown. Activities and programs will not affect the species.

Management Direction

Consideration for grizzly bears and their habitat in other resource related decisions is not directed. Maintenance of grizzly habitat is optional. Any grizzly involved in a grizzly-human conflict will be controlled.

HARVEST STRATEGIES

Montana is the only state among the conterminous 48 authorized to allow sport hunting of grizzly bears under the Endangered Species Act, granted by Chapter 1, Title 50 of the Code of Federal Reg., Part 17, Paragraph 17.4 (50 CFR 17.40), made effective August 1, 1975. This authorization to hunt established a mortality quota of 25 grizzlies for northwestern Montana, based on an annual mortality of 28 bears for the years 1967-1974. In 1985, an Emergency Federal Regulation reduced the quota to 15 grizzlies with a female subquota of 6 (Dood et al. 1986).

From 1975-1985, the average annual hunting mortality for this segment of the grizzly population was 10.2 bears/year (range 5-17) of which 3.8/year were females (38% of harvest). Adult females comprised 54% of the female harvest with a median age of 5; adult males comprised 47% of the male harvest, with a median age of 4 (a more detailed discussion of the harvest is presented in Dood et al. 1986). The combined adult to subadult ratio in the population is 51:49.

Indications are that the population in the NCDE has been stable or increasing since the early 1970s (Dood et al. 1986). If the current minimum population estimate were applied in 1974 (356 grizzlies exclusive of Glacier National Park), the quota of 25 individuals would result in a total mortality rate of 7%, a rate within that reported in the literature. Analysis of hunter harvest for 1975-85 shows a sex ratio of 63% males to 37% females, also similar to that in the literature (Table 16). Additionally, population data suggest that the reduction in the number of adults in the population from hunting increases survival and recruitment rates.

Age structure data from the Rocky Mountain East Front also indicate that this segment of the population is healthy and productive. Mean litter size, sex ratio of the harvest and hunter success are further indications of a stable or increasing population (Dood et al. 1986).

In the past several years, the grizzly bear hunting policy in Montana has come under close scrutiny. Because of this, a detailed Environmental Impact Statement was prepared in 1986. In addition to the conclusions stated above, several other points were presented as justification for the grizzly harvest. These are summarized briefly below (Dood et al. 1986);

1. there is indirect evidence that other remnant hunted populations survive, through genetic selection and learned behavior, by avoiding human confrontation and withdrawing from human contact
2. the average of 10 grizzly bears killed per year in the NCDE does not appear to be detrimental to the population

Table 16. **Recommended and reported grizzly bear mortality rates (from Dood et al. 1986).**

Reference	Hunter Harvest[a]		Total Mortality[b]		
	Total	Male/Female	Female	Adult	Total
Reynolds (1975)	3%				
B.C. Fish and Wildl. Branch (1979)		60:40			5%
Tompa (1984)			2%		3-5%
van Drimmelen (1984)		65:35	2%		3%
Sidororowicz and Gilbert (1981)	2-3%			4.5%	10.5%
Lortie and McDonald 1977, Lortie 1978	3%	61:39			
B. Smith (pers. commun. Yukon Wildl. Branch)	4%				
Martinka (1974)					17%
Craighead et al. (1974)					8.2% 14.4%
McCullough (1981)					13.2%
Cowan (1972)	5-7%				
Bunnell and Tait (1980)					10.7%
Harris (Unpublished)					6.4% 6.6%
Average annual mortality in the NCDE, 1967-1984	3%	59:41	4.5%	6%	6%

[a]Rate includes only man caused mortality.
[b]Rate includes all known causes of mortality.

3. hunters might legally harvest problem bears and, therefore, bear/human conflicts may be reduced
4. hunting may reduce the need for agency control of nuisance bears
5. Hunting may cause bears to become wary of humans as is shown in studies of other species in hunted *vs.* unhunted populations
6. hunting may increase cub survival and recruitment, resulting in a population increase.

Differential Vulnerability

Males are more vulnerable to hunting than are females. This is consistently demonstrated by the number of males harvested, higher apparent mortality rate of males in the capture data and higher actual mortality (Nagy et al. 1983b, Dood et al. 1986, Bunnell and Tait in press). There is also a differential vulnerability by age class as evidenced in the Montana data (Dood et al. 1986).

Several factors contribute to the differential vulnerability of age and sex classes in the harvest, between and within populations (Bunnell and Tait in press). These include;

1. hunter selectivity (e.g., avoidance of females with cubs; selection of large (male), grizzlies)
2. behavioral differences (e.g., hunting practices such as bear baiting, or shooting over gut piles that attract dominant males)
3. movement patterns of both hunters and bears (Bunnell and Tait in press)
4. vulnerability as affected by earlier emergence from dens and greater mobility (larger spring ranges) of males (Nagy et al. 1983b)
5. season dates influence the sex ratio of the harvest — early fall and late spring seasons result in a higher percentage of females in the harvest (Troyer 1961, Dood et al. 1986).

Troyer (1961) stated that because fall hunting produced a higher female harvest (i.e., earliest part of fall season is the most productive for females), seasonal restrictions would have the most significant result. Stirling et al. (1976), following this line of thought, stated that the fall seasons might be detrimental to the population as a whole because of the high female vulnerability. Additionally, because a decreasing proportion of females are reported in the fall kill as the season progresses, Pearson (1975) proposed postponing the early fall season until after females have denned.

Harvest Data

Several researchers have investigated the application of grizzly harvest data to population modelling in general

(Stringham 1980, Tait 1983, Harris 1984b, 1985ab, 1985b, 1986a, Bunnell and Tait in press).

Tait (1983) in his analysis of hunter kill data, stated that the description of the number of animals in the population over time will reveal both population trends and harvest impacts on the population. However, harvest data do not represent an unbiased sample of the overall hunted population; the age and sex distribution in the harvest does not necessarily reflect the age and sex distribution of the population (Tait 1983, Bunnell and Tait in press). This disparity suggests cautious use of these data as indicators of population size and trends. Harvest rates should be governed by more reliable evidence of how close a population is to the carrying capacity of its habitat (Stringham 1980).

Harris (1984b, 1985ab, 1985b, 1986a) developed several grizzly bear population models to determine the affects of various population characteristics and harvest strategies on the populations. Data required for these analyses include age specific natality rates (litter size, breeding interval, age of first reproduction), age specific survival in the absence of hunting, relative vulnerability to hunting by age and sex class, initial population age structure and responses of the above to lowered density caused by hunting (Harris 1985b). Details of the models are described in the papers discussed and are beyond the scope of this narrative.

Specific harvest regulations are presented by state/province in the following section.

Montana

(from Montana Dept. of Fish, Wildlife and Parks, 1986b Grizzly Bear Hunting Regulations)

Fees:	Conservation license (prerequisite):	$2.00
	resident:	$50.00
	non-resident:	$300.00
	trophy fee:	$25.00

Season: Legally described grizzly bear management areas (Rocky Mountain East Front, Scapegoat and Flathead) within the NCDE are open October 1, 1986 and will continue until 48 hour notice in appropriate bear management area if "total mortality quota or female subquotas are reached" but will close no later than Nov. 30, 1986.

Bag limits: One grizzly bear of either sex per license year.

Female bears with young and individual young may not be taken; young are defined as 2 years old or younger. To reduce the likelihood of taking a female grizzly, the regulations request that hunters, if possible, refrain from shooting grizzlies in groups of 2 or more. The grizzly license and tag must be attached to the hide immediately upon harvest. Evidence of the sex of the animal must remain intact on the carcass.

The Northern Continental Divide Grizzly Bear Ecosystem is divided into 3 bear management areas (see below). Montana is the only state/province that uses a quota system (Dood et al. 1986). In 1986, the quota for the ecosystem was set at a total of 14 grizzly bears (subquota of 6 females) killed by hunting or other human activity. Included in this total is the relocation of a grizzly or any other human action that leads to the loss of a bear from the ecosystem. Each of the 3 bear management areas has its own subquota at which the specific season will close on 48 hours notice when achieved. These areas and subquotas are:

> Flathead Bear Management Area: The season will close when 2 females have been killed.
>
> Rocky Mountain East Front Bear Management Area: The season will close when 3 females have been killed.
>
> Scapegoat Bear Management Area: The season will close when 1 female grizzly has been killed.

Prior to the start of the 1986 season (Sept. 19) a total of 9 grizzly bears remained in the overall quota; only 2 females remained within the female subquota — only 1 of which could be taken from the Rocky Mountain East Front. The season eventually closed on October 11, after the Dept. of Fish, Wildlife and Parks was notified that a sixth female grizzly had been taken by a hunter along the Middle Fork, Flathead River (Montana Dept. Fish, Wildlife and Parks 1986a).

Hunters accounted for 3 male and 2 female grizzlies killed of the total 10 removed from the ecosystem this year. One grizzly was relocated to a zoo; 4 died due to non-hunting, human causes (Montana Dept. of Fish, Wildlife and Parks 1986a).

Alberta

(from Alberta Fish and Wildlife Division, 1986 Summary of Big Game Regulations)

Fees:	all hunters:	$11.00	wildlife certificate and resource development stamp
	resident:	$20.00	license
	non-resident:	$125.00	license
	non-resident alien:	$250.00	license

Seasons: Seasons vary by zones, but in general are: 1) fall season, Sept. 10 — Nov. 29, northwest 2) spring authorizations, April 1 — May 15, Kananaskis Range area 3) general spring season, April 1 — June 2, northwest fourth of the province and 4) April 1 — June 13, zone along border of Banff and Jasper National parks.

Bag Limits: Resident, 1 per license (if successful in 1985, ineligible to purchase license in 1986). Non-residents and non-resident aliens, 1 per license (if successful in 1982,1983,1984 or 1985 ineligible to purchase license in 1986). Authorizations and special licenses (residents only) from a drawing can be applied once.

It is illegal to hunt or possess a grizzly under the age of 2 years, or a female grizzly accompanied by a cub under the age of 2 years. Grizzlies killed must be tagged through the hide and the hide and skull must be submitted.

British Columbia

(from British Columbia Ministry of the Environment, B.C. Hunting Regulations. Synopsis 1985-1986)

Fees:	resident:	$70.00	plus hunting license fee
	non-resident:	$320.00	plus hunting license fee

Seasons:	fall:	Oct. 1 - Nov. 19
	spring:	April 1 - May 31

Bag limits: Regional bag limits are set, with limited entry and non-resident quotas established for some regions. Some regions have a limit of 1 grizzly bear taken per 5 year period.

In British Columbia, as in other regions, grizzly bears cannot be taken when part of a family group. The taking of a grizzly must be reported immediately and the entire skull turned into the authorities.

During possession and transport, the hunter must leave attached to a portion of the carcass either: 1) a readily identifiable portion of the hide, not less than 6 sq cm in size or 2) either a testicle or part of the penis, or a portion of the udder or teats to identify the sex.

The first priority of grizzly bear management in British Columbia is sport hunting at a level which is not detrimental to the population (British Columbia Ministry of Environment 1979a, Van Drimmelen 1985). Management for hunting emphasizes the production and continued availability of large, mature, animals (British Columbia Ministry of Environment 1979c).

Proposed harvest levels should be based on biological considerations such as reproductive capability, movements and differential vulnerability of specific age and sex classes (Van Drimmelen 1985). Tompa (1984) stated that a 3% harvest level (or 2% of the female segment of the population) is a normally sustainable level of annual harvest. According to the management plan described for British Columbia (British Columbia Ministry of Environment 1979ab), the harvest should be directed toward males and held at less than 5% of local populations. When discussing these levels, consideration must be given to crippling loss, removal of problem bears and illegal loss (Woods and Hebert 1983, Van Drimmelen 1985).

Three sub-objectives of grizzly bear management were stated for British Columbia (British Columbia Ministry of Environment 1979ab). These are:

1. maintain the population at not less than 5000 animals distributed in the wilderness
2. provide an opportunity for people to view grizzly bears in their natural habitat
3. provide 6000 hunter days and an annual sustained harvest of 200 grizzlies (based on productivity of the population, allowable harvests, some area closures, habitat alterations and past hunting statistics).

Based on hunter sample returns for the period 1965-74, a harvest of 250 grizzly bears (27.7 bears/year) was estimated for 2 game management units. From 1975-81, a total of 87 bears were harvested from 3 units (13.4 bears/year) (Woods and Hebert 1983). From 1965-73 inclusive, non-residents harvested an average of 218 grizzlies; residents harvested 177, for a total of 396 grizzlies/year for that period (British Columbia Ministry of Environment 1979b).

In Woods and Hebert's (1983) study, females comprised 43% of the total non-resident harvest. Ideally the male/female harvest ratio should be close to 3/2, with 60% of the

harvest comprised of subadults (British Columbia Ministry of Environment 1979a). Age of grizzly bears harvested ranged from a high of 9.1 to a low of 4.3 years. The average female age was 6.3 years; average male age was 6.8 years. The fall season accounted for 69% of the harvest (Woods and Hebert 1983).

Trends in hunter harvest must be maintained and harvest levels reduced if overharvest is indicated. Such indicators are: 1) decreased hunter success, 2) decreased average age of harvest, and 3) increased female component of the harvest (Van Drimmelen 1985). Intrepretation of the historic and current harvest suggests that: 1) the average age of harvested bears must increase, 2) the number of females in the harvest must decrease, and 3) harvest between coastal management units must be redistributed (Woods and Hebert 1983).

As a result of this trend information, the following remedial measures may be required to assure a sustainable population (Woods and Herbert 1983, Van Drimmelen 1985);

1. regulations should change from protecting females with 1-year-old cubs to females with 2-year-old cubs (current regulations protect "family groups")
2. harvest limits will be imposed for non-residents (or formal quotas)
3. reduction in length of fall and spring seasons
4. limited entry restrictions should be imposed
5. total closure if needed
6. elimination of fall season as needed.

Future harvest levels should be based on a combination of harvest data analysis and relative population indices (Woods and Hebert 1983). Ideally harvest should be constantly maintained and checked against known population data (Tompa 1984).

Northwest Territories

(from Northwest Territories Renewable Resources, Summary of Hunting Regulations, 1986)

Fees:	Mountain Grizzly —		
	resident:	$5.00	license
	non-resident:	closed	
	non-resident alien:	closed	
	Barren Ground Grizzly —		
	resident:	$5.00	license
	non-resident:	$10.00	license
		$500.00	trophy fee
	non-resident alien:	$25.00	license
		$500.00	trophy fee

Seasons: Mountain Grizzly — Aug 15 - Oct 31, Zone E/1, northwest along Yukon border.

Barren Ground Grizzly — Aug. 15 - Oct. 31, Zones C/1-1, 1-2, 1-3, F/1-1, northcentral above Yellowknife, Fort Good Hope.

Bag limits: Mountain Grizzly — (residents only) — 1, any adult not accompanied by a cub; only one per lifetime.

Barren Ground Grizzly — (all hunters) — 1 or more, any adult not accompanied by cubs, in accordance with the number of tags held.

From 1965-1978, 397 bears, an average of 28/year, were taken in 2 game management zones (12 and 19) by non-resident hunters, declining at a rate of 2/year. No strict conclusions were made from the age structure of the harvest (Miller et al. 1982).

Based on the available harvest data, Miller et al. (1982) concluded that the harvest rates for this period were excessive, resulting in an overexploitation of the population. This resulted in a net immigration into the harvested area, which possibly resulted in a gradual, overall population decline for the entire area. The above stated hypothesis suggested that the ability of the population to sustain a harvest is limited. Some of the regulations have been changed to address these points.

Yukon

(from Yukon Renewable Resources, 1986/87 Yukon Hunting Regulations Synopsis)

Fees:	resident:	$10.00	license
		$25.00	seal
	non-resident:	$75.00	license
		$25.00	seal
		$500.00	trophy fee, male grizzly
		$750.00	trophy fee, female grizzly
	non-resident alien:	$150.00	license
		$25.00	seal
		$500.00	trophy fee, male grizzly
		$750.00	trophy fee, female grizzly

Seasons: Both spring and fall seasons vary by management zones. Briefly they are: 1) April 15 - June 21, Aug. 1 - Nov. 15, southwest corner, northeast of Kluane Natl. Park 2) April 15 - June 15, Aug. 1 - Oct. 1, extreme northwest and northcentral region 3) Aug. 1 - Oct. 31, southwest corner and 5) April 15 - May 30, Sept. 7 - Oct. 31, southwest corner, along British Columbia border (see regulations for more details).

Bag limits: Harvest limits vary by Game Management Zone for resident hunters from 1 grizzly per license year to 1 grizzly/3 license years.

A system of annual quotas to regulate non-resident harvest of grizzly bears has been replaced by a system of harvest points for the period April 1, 1985 to March 31, 1987. Points will be deducted for each male grizzly (1 pt.) and female grizzly (3 pts.) harvested by non-residents (1 pt. is also taken for each goat). This new system provides an incentive to harvest male bears and opportunity and flexibility for outfitters to operate their businesses.

Each successful hunter must present evidence of the sex of a harvested grizzly by submitting the skull of any female or skull and baculum attached to the hide of any male grizzly not more than 10 days later than season closure. Species seals must be affixed to the hide upon killing a grizzly and to the skull when prepared. Hunters who kill a female bear are requested to deliver the reproductive tract to the Dept. of Renewable Resources. Marked grizzly bears cannot be taken by hunters.

Harvest data in the Yukon over the past 20 years show that the number of bears harvested annually varies little and averages about 100 (Sidorowicz and Gilbert 1981). In central Yukon, females comprised 52% of the 1973-1976 reported kill. Harvest data revealed significant differences in the distribution of bears killed by time of day and sex: females most numerous in mid-morning and early afternoon and males in late afternoon (Smith in prep.).

Sidorowicz and Gilbert (1981), upon reviewing the harvest and population data, made the following recommendations;

1. total adult mortality must be restricted to 5% or less and sport harvest to 2-3% (100 or less bears/year)
2. if fewer females than males are taken, a higher total number can be harvested
3. obtain age and sex data from every kill so that harvest may be maintained and regulations for subsequent years adjusted
4. management strategies should avoid the use of quotas that may lead to a biologically detrimental harvest
5. the reestablishment of effective management zones based on ecophysical criteria should be considered.

Smith (in prep. c) recommended an active management strategy for sex-selective hunting to maximize harvest and protect the reproductive segment of the population. This has been addressed by initiation of the point system described above.

Alaska

(from Alaska Dept. of Fish and Game, 1986-1987 Alaska Game Regulations No. 27)

Fees:	resident:	$12.00	hunting license
		$25.00	big game tag (each)
	non-resident:	$60.00	hunting license
		$350.00	big game tag (each)

Seasons: Seasons vary by Game Management Unit but generally fall between Sept. 1 - Oct. 31 (fall season) and May - June (spring season). Seasons range from Sept. - May, mid-August - October, Sept. - December, and into July. See regulations for specific dates.

Bag limits: Limits also vary by Game Management Unit and are different for residents, non-residents and subsistence hunters. In general, the limit is 1 bear every 4 years, but varies to 1 bear per year. Some units have limits on the number of permits issued.

Neither a bear cub nor a female accompanied by a cub can be legally taken. Bear tags must be affixed to the hide, which must be salvaged along with the skull. Non-resident hunters must be acompanied by a guide or a resident over 19 years of age. The regulations differentiate between brown and grizzly bears.

In areas of intensive hunter use, brown bears will be managed for an optimum sustained yield of animals (Anon. 1980). Regulations in the past have been based on the fluctuation of trophy size bears, total take, chronology of the kill and the sex differential in the harvest (Troyer 1961). Seasonal restrictions have been imposed to control these factors.

In Alaska, the necessity for subsistence hunting must be a management goal within the limitations of a sustained yield. Additionally, certain areas of the state are managed to provide hunting opportunities with high aesthetic quality (Anon. 1980).

Troyer (1961), in examining the harvest, came to several conclusions. They are;

1. fall hunting success is lower than spring
2. the estimated illegal kill comprises 20-25% of the total kill
3. in fall, the earliest portion of the season is the most productive, gradually diminishing as bears approach denning
4. the spring kill is lowest in early April, gradually increasing until it reaches a peak in the latter part of May.
5. males comprise 65% of the harvest, attributed to selective hunting for size; males more in spring than in fall (68% and 59%, respectively).

Based on these factors Troyer (1961) recommended reducing or eliminating the early fall season to reduce the take of females in the harvest.

BIOGEOGRAPHIC CONSIDERATIONS

Shaffer (1986), motivated largely by recent work on the equilibrium theories of island biogeography (MacArthur and Wilson 1967), noted that traditional theories of extinction have been dramatically expanded. The traditional view held that species viability was constrained only by its ability to adapt to gradually changing environmental conditions or to survive rare global catastrophes. In recent decades, biologists have recognized that extinction may occur fairly often on a local scale, especially with small populations, due to various stochastic factors. Types of stochastic perturbations which can influence population viability include demographic stochasticity, environmental stochasticity, natural catastrophes and genetic stochasticity (Shaffer 1978, 1981, 1986). Habitat fragmentation and isolation exposes remnant populations (such as the Yellowstone grizzly bear population) to higher extinction rates due to the increasing importance of these stochastic forces (Shaffer 1983). Species preservation tactics which address only the sustained, systematic pressures confronting a population may prove inadequate for handling stochastic perturbations in the long-term.

Minimum Viable Population Size

Of fundamental concern is the population size threshold below which susceptibility to stochastic perturbations is so great that the probability of chance extinction approaches an unacceptable level. Shaffer (1978, 1981, 1983) termed this the minimum viable population (MVP) size and defined it for any given species as the population size below which the population had less than a 93% chance of surviving for 100 years. The MVP is a population that, within its particular biogeographic context, is able to not only maintain itself under average conditions but is also of sufficient size to withstand the various stochastic perturbations (Shaffer 1981). There are 5 approaches for determining MVP sizes (Shaffer 1981, Samson 1983, Samson et al. 1985): experimental, analysis of biogeographical patterns (observed distribution and extinction/colonization rates), analysis of genetic considerations, theoretical models and simulation models. Simulation models have several advantages over the other approaches including the ability to incorporate population-specific data on vital parameters

(mortality and fecundity rates) and to test the effects of changes in these parameters (Shaffer 1981).

Shaffer (1978, 1981, 1983) and Shaffer and Samson (1985) developed a stochastic computer simulation model to determine the relationship of population size to extinction probabilities for grizzly bears. The model used data for the Yellowstone grizzly bear population collected by the Craighead research team from 1959-1970. Density dependent relationships were determined from analysis of these data. Various versions of the simulations tested the effects of demographic or environmental stochasticity on population survival. Fifty replicates were run for each initial population size to determine the smallest isolated population having a 95% chance of surviving for at least 100 years. As first reported (Shaffer 1978, 1983), the MVP for the Yellowstone population was 35 to 70 bears; subsequent analysis detected 2 systematic errors in the original simulation leading to a new MVP estimate of 50-90 bears (revision in Shaffer 1983, Shaffer and Samson 1985). This corresponds to a minimum area requirement of 1000-13,500 sq km. A sensitivity analysis indicated that a slight increase in the specified mortality rate had a substantial impact on the estimated MVP.

Shaffer and Samson (1985) extended the simulation up to 300 years. Their modification enabled a more complete analysis of the variance in extinction times for different initial population sizes. This work showed that although a grizzly bear population of 50 had a .06 probability of survival for 300 years, 56% of these populations were extinct by 114 years (range of 24 to 300+ years). Another significant finding was the long survival times for populations having a low probability of ultimate survival. For example, no populations of 20 bears survived the 100-year test period, yet the average time to extinction was 44 years. Servheen (in press) noted that these findings had important implications for grizzly bear management.

Comparisons of the estimated times to extinction from the simulation model with the predictions of analytical extinction models revealed some striking differences (Sampson et al. 1985, Shaffer and Samson 1985, Shaffer 1986). The MacArthur and Wilson (1967) equilibrium island biogeography model produced an expected time to extinction of 8336 years for an initial population of 50 grizzlies. The more sophisticated structure of the Shaffer simulation model accounted for the great difference in estimated extinction times (8336 years vs. 114 years) between the analytical and simulation results. The simulation model also incorporated the effects of environmental stochasticity and population age/sex structure in its analysis, neither of which was included in the MacArthur and Wilson analytical model.

Several weaknesses of the simulation model were discussed. Lack of generality was one difficulty. The model required detailed, population-specific data on basic life-history parameters. These data were available only through intensive, long-term studies of individual populations (Shaffer 1981, 1983). Another weakness was the inability to incorporate genetic considerations in the simulations. Shaffer and Samson (1985) felt that inclusion of genetic factors could increase the simulated extinction probabilities substantially.

Suchy et al. (1985) modified Shaffer's model to reflect more recent (1975-1982) Yellowstone grizzly bear data. As with Shaffer's earlier work, this model simulated the effects of both demographic and environmental variation. Simulations were run using 2 different mortality estimates. The lower mortality rate was based on confirmed mortalities only; the higher mortality rate included 7 additional suspected mortalities. The lower mortality estimate yielded an MVP of 40 bears while the higher mortality estimate yielded an MVP of 125 bears. Thus, as noted previously regarding Shaffer's sensitivity analysis, the addition of a few mortalities drastically changed the prognosis for a given bear population.

Management Applications of MVP Concepts

Minimum viable population analyses provide the grizzly bear manager with knowledge about the susceptibility of various sized populations to stochastic perturbations. Although MVP analysis can determine the probabilities of persistence for a given population size, the actual outcome is stochastic and therefore can not be predicted beforehand. A population of 50 grizzly bears will survive an average of 114 years, but over half of such size populations become extinct in less than 114 years. Grizzly bear managers are not indifferent to that outcome (Samson et. al. 1985).

Attempts to transfer the simulation results to other grizzly bear populations must recognize the great variability in vital parameters between populations (Shaffer 1978,1983,1986). The nature of the ecosystem, or reserve, in terms of habitat security and management intensity, is also critical to the application of MVP concepts (U.S. Fish and Wildlife Service 1982a, Shaffer and Samson 1985).

Based on the findings of Shaffer (1978), the Grizzly Bear Recovery Plan (U.S. Fish and Wildlife Service 1982a) established a recovery goal for the Cabinet-Yaak grizzly bear ecosystem of 70 bears within 1,818 sq miles of occupied habitat. The plan notes that management according to MVP objectives alone could mean maintaining grizzly bears at threshold numbers at which unpredictable catastrophes could plunge the population toward extinction.

The evolving views on the dynamics of extinction have led to an increased appreciation by management agencies that viable population problems must play an integral role in endangered species management (Shaffer 1986). Salwasser et al. (1983) discussed the legal and ethical mandates to manage National Forest land to maintain viable populations of vertebrate species. As Shaffer (1986) observed:

> The grizzly bear MVP analysis has been useful primarily in elucidating the problem of species conservation where habitat area and population size are key issues; providing a conceptual framework for defining population viability; and demonstrating what can be done with available information to better assess the possible long-term consequences of short-term management decisions.

HUMAN ATTITUDES

A number of surveys have been conducted to evaluate public attitudes toward the grizzly bear and grizzly bear

management, and general public knowledge about bears. Some of these studies also attempted to identify factors which influenced these attitudes. While an attempt was made herein to compare results from these studies, it must be emphasized that considerable variation existed in the instruments employed (questionnaire or survey), the sample size and the population sampled. Additionally, there was a 15 year time span between the earliest (March 1970) and most recent studies (Frost 1985, Sundstrom 1985, Maw in progress). Such factors must be considered when reviewing findings of these studies and apparent contrasts must be approached cautiously. A brief overview of the most important surveys is provided below:

Marsh. 1970, 1972.
Personal interviews of visitors to Banff and Glacier National parks (B.C.) (n=114) concerning general knowledge and attitudes toward bears and bear management programs.

Bryan and Jansson. 1973.
A questionnaire survey of 393 persons in 3 Alberta communities included a cross-section of geographic areas (representing different levels of opportunity for exposure to grizzly bears and other wildlife) and a breakdown by: park visitors vs. non-park visitors and hunters vs. non-hunters. Designed to evaluate perceptions of hazard and general attitude toward wildlife.

Freeman-Haet. 1973.
Questionnaire administered to visitors (all use categories) to Glacier National Park (n=312). Designed to analyze the perception of the grizzly bear image of the general public.

Hodgson. 1974.
Analyzed the effects of different types of grizzly bear warning messages on perceptions and behavior of wilderness survival students (n=78).

Mihalic. 1974.
Questionnaire survey of visitors to Glacier National Park, Montana (n=150) to evaluate attitudes, knowledge, information sources and experience regarding grizzly bears. Included a complex, detailed analysis of "intervening factors" (e.g., place of residence, age) which influenced attitudes toward bears.

McAllister. 1977.
Random sample questionnaire of Vancouver area residents (n=42) and Sierra Club members in Vancouver area (n=70) to assess overall attitudes, knowledge and information sources regarding grizzly bears.

Perry. 1977.
Informal interview of visitors and residents to the North Fork of the Flathead Valley (NCDE) regarding attitudes toward grizzly bear management and behavior in bear country (sample size not available).

Post. 1982.
Questionnaire survey of visitors (n=79) to the Pack Creek brown bear reserve on Admiralty Island National Monument. Evaluated attitudes toward bears, bear encounters and visitor activities.

Fortier. 1983.
Questionnaire survey of visitors to Yellowstone National Park (n=274, including 137 inbound and 137 outbound visitors). Designed to evaluate effectiveness of bear information dissemination in the park. Included cross section of all user categories.

Frost. 1985.
Questionnaire survey from households in Mission Valley, Montana (n=154) to evaluate residents' knowledge, attitudes and experience with grizzly bears (note that 71% of the residents sampled had seen a grizzly bear in the wild.)

Sundstrom. 1985.
Questionnaire survey of visitors, employees and professionals at Denali National Park, Alaska. Evaluated attitudes, and knowledge regarding bears and effectiveness of visitor education efforts. (n=2384).

Maw. In progress.

General Attitude Toward Grizzly Bears

Several studies conducted in Canadian and American national parks showed predominantly favorable attitudes toward the grizzly bear. Sixty-five percent of the Glacier National Park visitors surveyed had positive sentiments about the grizzly bear (20% neutral, 15% negative; Mihalic 1974). An associated study indicated that the aesthetic qualities of the grizzly were the strongest components of the positive image (Freeman-Haet 1973). In Waterton National Park, grizzly bears were valued for their ecological role (32% of respondents), their aesthetic attributes (25%) and for moral considerations (12%). Only 5% of the respondents had negative attitudes about the grizzly (Maw in progress). In the Pack Creek reserve for brown bears in Admirality Island National Monument, 60% of the visitors who had seen one or more bears felt that the experience had added to enjoyment of their trip. Sixty-seven percent of those who had seen "lots of bears" said that the experience had "extremely added" to their trip (Post 1982).

Studies conducted outside of the parks and reserves also showed generally favorable attitudes toward the grizzly. In the Mission Valley, 61% of the residents said they liked grizzly bears, 27% disliked grizzlies and 12% were uncertain or neutral. Fifty-five percent of these residents felt that having grizzly bears in the Mission Valley contributed to their quality of life. Thirteen percent felt that the grizzly bear did not add to their quality of life. Sixteen percent and 11% favored reducing (or eliminating) grizzly bears in the Mission Valley and the United states, respectively (Frost 1985). An informal survey in the North Fork of the Flathead Valley revealed that 84% of the users wanted to have grizzly bears in the area, 11% were neutral and 5% preferred to have no grizzlies (Perry 1977). Only 20% of the Vancouver Island residents surveyed by McAllister (1977) had positive attitudes toward the grizzly, 20% were "concerned," 41% were "cautious" and 14% were negative (definitions of these terms were not provided).

Perception of Danger and Effect on Human Activities

Several surveys attempted to assess the visitor's perception of danger from grizzlies and the effect this perception had on their activities in bear country. Bryan and Jansson (1973) surveyed Alberta residents from 3 different areas of the province. Overall, 57% of the respondents felt that

grizzly bears were dangerous and 12% felt "personally endangered" by grizzly bears. In Banff and Glacier National parks, 20% of the visitors were discouraged from hiking because of the presence of bears and 10% were discouraged from camping because of the presence of bears (Marsh 1970). Perry (1977), found that 89% of the visitors encountered in the Flathead Valley would not avoid an area specifically because of grizzly bear presence. In Yellowstone National Park, 40% of the outgoing visitors claimed that they would be willing to assume some risks for the opportunity to see bears. Twenty-eight percent of these visitors felt that the danger from bears was overrated and 42% favored the establishment of some sort of controlled viewing area (Fortier 1983).

Knowledge About Grizzly Bears

Several studies evaluated the knowledge level of the general public and park visitors concerning bear biology and management. Higher knowledge levels were generally associated with increased exposure to bears and participation in outdoor activities (Bryan and Jansson 1973, Mihalic 1974, McAllister 1977, Fortier 1983, Frost 1985, Sundstrom 1985). The relationship between knowledge level and attitude toward grizzly bears was less conclusive. Frost (1985) reported that Mission Valley residents with favorable attitudes toward grizzlies tended to have more knowledge about bears and more experience with bears in the wild. Residents who opposed reducing or eliminating the Mission Valley grizzly population were likely to have more knowledge about grizzly habitat needs and behavior than those with the opposing viewpoint. Similarily, there was a significant relationship between knowledge and positive attitude for visitors to Yellowstone National Park (Fortier 1983).

Conversely, Mihalic (1974) reported that for visitors to Glacier National Park, knowledge of bear biology was not a valid indicator of attitude. Past behavior (i.e., outdoor experience) was also not significantly related to attitude unless the interviewing factors of visitor origin and, to a lesser extent, age were incorporated into the analysis. Those visitors who had previously seen bears were equally divided between positive, negative and neutral attitudes.

Attitudes Toward Bear Management

Attitudes toward bear management goals and activities were discussed in several reports. Marsh (1970) found that 70% of the Canadian park visitors surveyed felt that removal and relocation, rather than killing, were the best control methods for first-offense nuisance bears. Nineteen percent said that troublesome bears should be shot when first detected and 10% felt that bears should be left alone regardless of their offense. Bryan and Jansson (1973) reported that a significant majority of Alberta residents believed that animals causing property damage should be removed and those causing human injury should be destroyed. In the North Fork of the Flathead Valley, 63% of those surveyed felt that relocation was appropriate for nuisance bears; 26% favored killing nuisance bears; and 11% felt no action should be taken (Perry 1977). Residents of the Mission Valley overwhelmingly agreed (98%) that they would kill a grizzly for protection of self and family (Frost 1985). Fifty-one percent would kill a grizzly for livestock depredation. Increased willingness to kill a grizzly was associated with lower knowledge about grizzly habitat needs and behavior (other factors were also discussed).

Visitors to Waterton National Park showed some surprisingly encouraging attitudes concerning bear management (Maw in progress). All of those surveyed felt that bear injuries were human caused. When asked whether bears or people should have priority in management of a certain valley, 56% gave priority to bears in all circumstances and 4% gave full priority to bears only when in prime bear habitat. Only 6% gave full priority to people. If bear problems arose, 20% of the visitors favored people management, 75% favored relocation and only 3% favored killing nuisance bears. In the case of repeat offenders, 8% favored people management and 11% favored killing the incorrigible bear.

Effectiveness of Information Programs

Three studies evaluated the effectiveness of park bear information programs. Fortier (1983) reported that exposure to Yellowstone National Park bear information had no significant effect on visitor knowledge concerning bears. Conversely, Sundstrom (1985) found that visitors departing from Denali National Park showed a highly significant increase in knowledge compared to arriving visitors. This finding did not apply to those classes of visitors with the least chance of encountering bears (e.g., day users, hotel guests and tour bus passangers). However, some attitude changes after exposure to park information sources were counter to bear management goals. Compared to inbound visitors, outgoing visitors were more willing to take risks to see bears and more likely to feel that park bears were unusually tame. Written information was the most effective method for disseminating knowledge.

Hodgson (1974) analyzed the effectiveness of different types of warning messages on subjects' perceptions of the grizzly bear. He found that although grizzlies were not rated as more dangerous by subjects exposed to strong threats, the subjects' anxiety level and predilection toward aggressive behavior increased with increased exposure to inhibition threats (i.e., threats which emphasized gruesome consequences of attack).

AVERSIVE CONDITIONING, DETERRENTS AND ATTRACTANTS

The research and development of non-lethal techniques for controlling problem bears is a relatively new field. To date, most of the work concerning deterrents, repellents and aversive conditioning has focused on canids, deer, birds or laboratory animals (Hunt 1983).

Hunt (1983) recently prepared a comprehensive, annotated bibliography on topics concerning aversive conditioning and deterrents. Over 400 citations, cross-referenced by species and subject, are included. Follmann et al. (1980) also reviewed the literature on carnivore deterrent methodologies and made recommendations for a carnivore control program for the Northwest Alaskan Pipeline Project. Both of these reports incorporated information from research

studies on non-ursid species. The following discussions will adhere primarily to techniques which have been tested with bears. Readers interested in a more exhaustive treatment of deterrent/repellent research are urged to consult the above-mentioned reports.

Hunt (1983, 1984, 1985) noted that these was a general lack of distinction in the literature between the terms repellents, deterrents and aversive conditioning and suggested the following definitions:

1. *Repellents* are activated by humans and should immediately turn a bear away during a close approach or attack.
2. *Deterrents* should prevent undesirable behaviors by turning bears away before a conflict occurs and need not be monitored or manually activated by humans.
3. *Aversive conditioning* should modify previously established undesirable behavior through the use of repellents or deterrents. This conditioning must be repeated until avoidance of people or their property has been firmly established.

The use of deterrents and repellents should be considered as a second line of defense against bear nuisance behavior. These systems should aid but not substitute for other preventative measures that reduce the possibility for bear-human encounters such as excluding bears from the resource or decreasing its attractiveness (NPS 1984, Hunt 1985).

Aversive Conditioning

Aversive conditioning is a specialized form of learning that involves pairing a normally desirable food, space, object or event with a negative reinforcement. This process leads to an avoidance of the former attractive stimulus (Dorrance and Gilbert 1977, Follmann et al. 1980).

The effect of an aversive conditioning program depends on individual and species behavior, the character of the resource and the selection of the appropriate aversion stimuli and substrates (Dorrance and Gilbert 1977). The type of resource being damaged (i.e., live prey versus other types of food or attractants) is of particular importance. Predation may be more difficult to suppress than, for example, scavenging because predation involves a more complex array of motivational systems (searching, chasing, killing and eating) than does scavenging (searching and feeding) (Dorrance and Gilbert 1977).

Aversive conditioning of bears involved in nuisance behavior can provide an alternative to relocation or destruction of problem bears (Hunt 1984). However, these methods are generally expensive, time consuming and often ineffective as long-term solutions.

Emetics

Several researchers experimented with the use of emetics and noxious chemicals to condition bears to avoid certain attractants or conflict situations. Emetics are nausea-producing agents which require ingestion to be effective whereas noxious substances are any chemical compounds which are distasteful or discomforting when inhaled or contacted (Follmann et al. 1980). Unlike emetics, noxious substances are theoretically effective upon first exposure and do not require a "conditioned" response. Hence, these chemicals will be discussed in the subsequent section on bear deterrents and repellents.

Impetus for research into aversive conditioning of bears through the use of emetics arose from their successful application with canids. Reviews of the use of emetics for aversive conditioning in canids and other mammals are provided in Follmann et al. (1980) and Wooldridge (1980). Among the most common emetics used as aversion control agents are lithium chloride, sodium salicylate, syrup of Ipecac, apomorphine (a narcotic with limited availability), peruvoside and ovabain (Follmann et al. 1980). Of these, lithium chloride (LiCl) has shown the most promise and has been most frequently used with bears.

Gilbert and Roy (1977) found that LiCl showed good potential for reducing the amount of black bear damage to Alberta beeyards. The best results were achieved by using both LiCl baits (LiCl capsules wrapped in honey or brood comb) in combination with electric fencing. However, subsequent testing of LiCl and cupric sulfate (CuSO4) in honey baits failed to reduce black bear damage in beeyards; the researchers concluded that LiCl was not an effective emetic for this purpose (Dorrance and Roy 1978). Hastings et al. (1981) attempted to avert bears to a particular food by feeding them LiCl pellets placed in hot dogs. No definite results were documented due to problems in identifying treated bears and other difficulties.

Wooldridge (1980) experimented with the use of three emetic compounds [LiCl, emetine hydrochloride (EHCl) and alpha-naphthyl-thiourea (ANTU)] for aversive conditioning of captive and free-ranging black and polar bears. Two captive black bears fed baits containing LiCl and EHCl avoided untreated bait for 3-8 days after exposure. The bears' pre-exposure diet (starvation level) influenced their reluctance to subsequently accept the untreated bait. Wooldridge also found that when livestock carcasses were treated with ANTU and LiCl, the time required for free-ranging black bears to consume the carcasses rose by 44-55%. All 3 emetic compounds reduced the consumption of baits by free-ranging black and polar bears at dumps. The effective dosages and relative merits of each compound were discussed.

A number of problems with the use of emetics have been noted. Foremost among these is the over-specificity of the resulting aversions; bears may be conditioned to avoid only the particular food(s) used as bait (Revusky and Bedarf 1967, Dorrance and Gilbert 1977, Follmann et al. 1980). While some success may be possible in instilling aversions to specific items, much bear nuisance behavior is oriented toward several or many attractants as at dumps. Achieving aversive conditioning to the wide variety of human attractants encountered by bears may not be possible (McCullough 1981). The best success with the use of emetics is achieved when the bait substrate closely approximates the item being damaged (Dorrance and Gilbert 1977, McCullough 1981).

Wooldridge (1980) acknowledged the problem of bait-specific aversions induced by emetics. He maintained, however, that continued noxious experiences at a particular bait site (e.g., a dump) should lead to a "location avoidance" response — a general reduction in visits to that site. Dorrance and Gilbert (1977) felt that barriers and repellents would be more effective than aversive conditioning in

the protection of a particular area, unless an animal was motivated to approach that area by a specific hunger.

Studies with coyotes have shown limited success with inducing aversions to prey killing through the use of emetics in dead prey (Gustavson et al. 1975, as reported in Miller 1983; Gustavson et al. 1976 as reported in Follmann et al. 1980). However, other studies suggested that although some test animals learned to avoid LiCl-treated baits, killing of live prey was not diminished (Conover et al. 1977; Shumake et al., unpublished data as reported in Wooldridge 1980).

Another major problem with the use of emetics is that animals can "learn" the taste of the emetic and avoid only the baited foods (Follmann et al. 1980). Dorrance and Gilbert (1977) felt that the emetic must not alter the acceptability of the bait either by repellency or contrasting flavor characteristics. Several authors noted that the large volume required and salty taste of LiCl made it difficult to administer a full dose (Gilbert and Roy 1977, Wooldridge 1980). Wooldridge (1980) also reported that the hygroscopic nature of LiCl may have altered the surrounding tissues and affected their palatability.

Another problem encountered in the field application of emetics is determining the proper dosage for effective treatment of free-ranging bears of varying size, health and motivational state (Wooldridge 1980; Hastings et al. 1981). Some emetics, such as ANTU, are potentially lethal in large doses (Wooldridge 1980).

The uncertain duration of the aversive response induced by emetics is also a problem (Follmann et al. 1980). Wooldridge's (1980) data showed that 2 black bears which were given emetic-laced bait reluctantly sampled untreated meat after several days of starvation. The availability of alternate sources of food will affect the success of any aversive conditioning program (Dorrance and Gilbert 1977).

In conclusion, it appears that although some tests have been encouraging, the use of emetics as a bear control method is presently limited by the lack of a colorless, tasteless and non-lethal chemical, by the specificity of the created food aversion and by problems with dosages and field applications (Gilbert and Roy 1977, Follmann et al. 1980, Wooldridge 1980, Hunt 1985).

Aversive Conditioning with Captive Bears

Programs designed to apply aversive conditioning to captive bears have been very limited to date. Brady and Maehr (1982) reported that the trauma of capture and release was itself sufficient to deter further damage to beeyards in Florida. Greene (1982) applied the principles of classical conditioning and behavioral technology to a nuisance black bear. The bear was trained to associate a neutral, ultrasonic tone with the aversive sound of a loud boat horn. One post-release test was conducted in which the bear was successfully repelled from a well-baited campsite by the ultrasonic tone alone.

Researchers with the Border Grizzly Project in Missoula, Montana, have developed methodologies for aversively conditioning nuisance grizzly bears in captivity. Suggested procedures included repellent and deterrent tests in captivity and intensive post-release monitoring accompanied by various aversive conditioning tactics should the bears enter any conflict situations (Jonkel 1982b, Anon. 1983b).

Hunt (1984) delivered repellents to 1 black bear yearling and 2 grizzly bear cubs (held in captivity in the Border Grizzly Project facilities in Missoula, Montana) and a black bear adult temporarily restrained by an Aldrich leg snare. The objective was to aversively condition these nuisance bears to avoid humans and human proximity. The repellents used included an air horn, Bear Skunker and Halt (capsaicin product). The fate of the bears after release was not determined, but none of the 4 bears was known to have caused additional trouble or was reported in the hunter harvest.

Jonkel (pers. commun.) reported that over 50 black bears and 6 grizzly bears have been aversively conditioned by Border Grizzly Project researchers in British Columbia and Montana. Of these, only 2 black bears and 1 grizzly bear were reported to have encountered further conflict; the grizzly bear was involved in a different sort of conflict than that for which it had been aversively conditioned. Jonkel noted that the primary aim of the conditioning program was to train bears to avoid people and recent human scent; attempting to negatively condition bears to avoid all of the vast array of potential attractants was not a realistic objective. Reports on the Border Grizzly Project's aversive conditioning program are forthcoming (Jonkel in prep., Klassen in prep., M. Smith in prep.).

Other Aversive Conditioning Research

Researchers in Yosemite National Park developed a conditioning program to break the positive link between backcountry camper food and the item which nuisance bears most often oriented toward — the foodsack (Hastings et al. 1981, Hastings and Gilbert 1981). Their tests involved hanging "aversion sacks" containing ammonium hydroxide-filled balloons in the camp. Bears seeking food in these sacks ruptured the balloons containing the noxious chemical. Favorable changes in bear behavior were documented in the limited area where the conditioning took place.

Researchers in Denali National Park have used aversive conditioning techniques to deal with black and grizzly bears which showed signs of learning to aggressively seek human foods (Jope 1983b, Dalle-Molle 1984, NPS 1984a). Their technique involved setting up a test camp near the site of a recent bear depredation. A food cache is placed 15-20 m from the tent. If a bear approaches the cache, it is drugged and radioed. Another test camp is set up near the bear the following day and if it approaches this camp, it is hit with a plastic bullet (discussed later). This procedure is repeated until the bear no longer approaches the camps or shows any aggressive behavior. Resource managers in Denali feel that aversive conditioning may be successful in the park because bears there do not have a long history of intensive use of human foods, human foods do not constitute a major portion of the diet and bears in Denali do not exhibit the strong aggressive behavior found in other areas (NPS 1984a).

Follmann et al. (1980) suggested another technique for aversive conditioning of problem bears which has been successfully applied to dogs and laboratory animals. Offending bears could be trapped and fitted with electroshock collars which could be remotely triggered to deliver a

painful shock to the bear whenever an undesirable behavior was repeated. Drawbacks of this approach included the expense of the collars and the time required to trap each bear twice (to fit and later remove the collar) and to monitor their activities.

Electric Fencing

General

Bear-proofing or complete physical containment of an attractant is the optimal means to avoid bear problems. Where this is not possible, electric forces provide the next most effective option (Hunt 1985).

Electric fences have been widely and successfully used to isolate attractants from black and grizzly bears (Follmann et al. 1980, Herrero 1982, Hunt 1985). However, success with polar bears has been minimal (Stenhouse 1982, Anon. 1983b, M. Bromley 1985).

Much of the relevant literature on electric fences relates to the prevention of black bear damage to beeyards or apiaries. Follmann et al. (1980) provided an excellent review of the available literature on the use of electric fences. As they observed, much of the reason for the large number of reports on fences is the ever-increasing sophistication of electrical fence equipment and design.

Electric fences were used to deter brown bears at salmon spawning streams on Kodiak Island as early as 1951 (Clark 1960, Gard 1971). These early systems, although relatively simple structures by later standards, were fairly effective when installed prior to initiation of the spawning run. Gard (1971) noted that the primary effect of fencing streams was to displace bear predation to other non-fenced streams.

Electric fences were used to exclude grizzly bears from garbage dumps in and around Yellowstone National Park beginning in the early 1970s. Hepburn (1974) reported that a high voltage (12000 v), low amperage (22 ma) electric fence, 2.7 m high and 0.9 m buried, was 100% effective in preventing bear penetration. A mat of wire netting was laid on the substrate around and connected to the fence to improve the ground. The same design was later used successfully in Denali National Park (Herrero 1982).

Greer (1972b, 1976b) reported that a 3.3 m high chain link fence with 0.9 m buried and surrounded by an electrified 3 wire stock fence failed to prevent grizzlies from entering the West Yellowstone dump. Grizzlies gained access to the dump by going both under and over the fence. Later modifications improved the system and alleviated many of the problems at the dump (Whitman pers. commun., in Follmann et al. 1980).

At Banff and Jasper National Parks, traditional, unburied, chain link fences did not deter grizzly bears from using park dump sites (Follmann et al. 1980). Later electrification of the fence at Jasper (with a grounded wire mat surrounding the fence) prevented bear access (Herrero 1982).

Electrical and physical barriers were highly effective in preventing bears from entering 2 large work camps during preliminary testing for the proposed Northwest Gas Pipeline in Alaska. These camps, which had experienced major bear problems during an earlier project, were active for 2 full summers with virtually no bear problems (Herrero 1982). The barriers were designed according to the recommendations of Follmann et al. (1980).

Fence Design and Specifications

Reviews of successful fence designs are provided by Follmann et al. (1980), Herrero (1982), Wooldridge (1983) and Hunt (1985). More detailed specifications, including diagrams, are available in those reports. The following conclusions were drawn primarily from their recommendations.

1. Fence designs adequate to deter black bears may not be effective for grizzly bears (Follmann et al. 1980).
2. Various charges have been used, but, in general, high voltage (10000 V or more) and low amperage (1 amp or less) will ensure that a sufficiently painful jolt is administered if contact is made (Herrero 1982). Wooldridge (1983) recommended voltages high enough to cause muscle tetany (60 sq kv wave DC pulse at a frequency of 40 hz) for use with polar bears. He found that a nominal 200 kv charge was required to reliably arc through a 6 cm patch of dry polar bear fur. Pulse frequency is also an important electrical consideration (Follman et al. 1980, Wooldridge 1983).
3. Barbed wire will ensure better contact than smooth wire (Follmann et al. 1980, Herrero 1982, Wooldridge 1983).
4. Achieving an effective ground can be difficult on dry or frozen substrate (Follmann et al. 1980, Herrero 1982, Wooldridge 1983). This problem can be corrected by laying a grounded, wire-mesh mat around the fence (Hepburn 1974), using a grounded upright chain link fence in combination with positively charged overhanging wires (Herrero 1982) or by placing charged wires an appropriate distance outward from the grounded fence so that an intruding bear will contact both wires (Follmann et al. 1980).
5. Some authors suggested that baits be attached to the charged wires so that a bear would contact the wire with the non-insulated nose or mouth and receive a more effective shock (Ridley 1976, Wooldridge 1983, Hunt 1985). However, Follmann et al. (1980) cautioned against the use of baits before bear problems developed as they could act as an unnecessary attractant.
6. Bears must be prevented from digging beneath a fence by a wire mat, buried fence, concrete pads or other physical obstructions (Follmann et al. 1980, Herrero 1982).
7. Fences must receive regular, proper maintenance to operate effectively (Ridley 1976, Follmann et al. 1980, Herrero 1982, Hunt 1985).
8. Gates represent an unavoidable weak point with any electric or physical barrier. Follmann et al. (1980) suggested 2 types of gates for use at construction camps which, with proper attendance, should prevent bear entrance.

For some purposes, as when bears must be excluded from the area around a temporary attractant, a portable electric

fence may be preferable to the elaborate permanent structures described in the preceding section. Wynnk and Gunson (1977) described a portable electric fence which effectively deterred black bear depredation at Alberta beehives. Hunt (1985) reported that a portable, high-visibility electric fence was effective in preventing depredation in 95% of 500 black bear incidents. The fence also prevented 11 of 14 grizzly bears which contacted the fence from engaging in further depredation. The principle component of the fence is an electrified, highly visible, yellow webbed ribbon (VGS). The ribbon is pre-baited with a food odor so that bears will be attracted to the ribbon and receive a shock.

Noxious Chemicals

General

While a variety of chemical compounds have been assumed to have deterrent properties, formal research into the use of noxious chemicals as bear repellents and deterrents is relatively recent. (Miller 1980, 1983, in press, M. Smith 1983, Hunt 1984, Rogers 1984). Since some chemicals have been found to have both repellent (actively sprayed) and deterrent (poured on a passive attractant) capabilities, both groups are discussed herein.

Capsaicin Products

One of the most promising repellents yet found for grizzly and black bears is capsaicin, an ingredient of cayenne peppers. Capsaicin is widely used as a dog repellent and is commercially available (Halt, Dog Shield and Animal Repel) in spray cannisters of various sizes (Hunt 1984, 1985). The compound is a powerful local irritant of sensory nerve endings which appears to cause no long term damage to skin or eyes of people or test animals (Rogers 1984, Hunt 1985).

Capsaicin products have been tested on captive and free ranging bears (Miller 1980, 1983, 1985a, in press, M. Smith 1983, Hunt 1984, Rogers 1984). Miller (1980, 1983) found that Halt effectively repelled polar bears in laboratory tests. After being sprayed, charging bears immediately retreated and rubbed their eyes. This product, like other chemicals Miller (1980, 1983) tested, did not deter polar bears from approaching baits treated with the chemical. However, bears did spend significantly less time at chemically contaminated bait sites than at untreated bait sites (Miller 1980,in press). Hunt (1984) also reported that capsaicin products did not appear to be effective deterrents when placed on or around baits.

Hunt (1984, 1985) tested capsaicin spray on captive black and grizzly bears and on free-ranging black bears. Capsaicin and a Capsaicin/Bear Skunker (synthetic skunk odor) combination elicited the strongest repellent response of any chemicals tested on captive bears. These chemicals also reduced the number of subsequent charges by treated bears. Smith (1983) reported comparable results with 3 captive grizzly bears and 1 captive black bear. In both Hunt's (1984, 1985) and Miller's (1980, 1983, in press) studies, the bears were provoked to charge before being sprayed.

Rogers (1984) sprayed 5 free-ranging adult black bears in the eyes with capsaicin. All 5 retreated although 1 large male returned and was sprayed 3 more times before leaving the area. M. Smith (in prep., in Hunt 1985) conducted a similar test with comparable results; 3 bears were immediately repelled while 1 male responded more slowly to the spray.

Hunt (1984) and M. Smith (1983, in prep. in Hunt 1985) sprayed free-ranging black bears with capsaicin using remote-controlled devices to release the chemical. Bears were repelled during 63 (88%) of the tests and no aggressive reponses were observed. Responses (immediate vs. slow retreat) appeared to depend on the individual bear, the activities of other bears and the availability of other, natural foods (Hunt 1984). Failure of capsaicin to repel some bears may have been due to the spray missing the eyes, poor quality of commercial product or higher tolerance of some bears for the chemical (Hunt 1984, M. Smith pers. commun., in Hunt 1985). Bears repelled by the remote controlled devices often returned to feed at the site in less than a half-hour (Hunt 1984, 1985, M. Smith in prep.). Capsaicin has been used once to repel an attacking, free-ranging grizzly bear in Yellowstone Park with favorable results (Hunt 1985).

The usual behavior pattern for bears sprayed with capsaicin was immediate and vigorous retreat, stop, head shake, paw at face, re-orient and move away (Miller 1980, Hunt 1984, 1985, Rogers 1984, M. Smith in prep.). No aggressive responses have been noted in lab or field tests (Hunt 1985).

Limitations in the use of capsaicin products are that the chemical must be sprayed in the eye to be effective and dispensers presently available have a limited range, accuracy and volume (Hunt 1984, 1985, Rogers 1984). However, improved dispensers are presently being developed (Hunt 1985).

Other Noxious Chemicals

Miller (1980, 1983) tested the deterrent effects of several common household chemicals (e.g., onion juice, ammonia, mustard) and commercial repellents on captive polar bears. He found that the household chemicals were generally effective in repelling the bears, but the capsaicin product (see preceding discussion) elicited the most dramatic response. Miller (1980,in press) tested various household chemicals poured on sardine baits as passive deterrents for free-ranging polar bears. Bears were repelled from treated baits only 5 times out of 294 visits, each time by Pine-Sol. However, as noted previously, bears did spend significantly less time at treated baits.

M. Smith (1983) tested the effects of 5 chemicals as repellents and deterrents for black and grizzly bears. Two capsaicin products (Phaser and Halt) had the strongest repellent effect on captive bears (see previous discussion), but Bear Skunker (an artificual skunk mercaptin) also caused slow, controlled retreats and inhibited subsequent charges. Bear Skunker also had the greatest deterrent effect with wild black bears at a dump site; only 1 bear of 11 returned to the bait station where he was sprayed with Bear Skunker. M. Smith (1983) noted that wild skunks might provide some reinforcement for the use of this compound. Two other chemicals, Child's 5-B (test product containing ammonia) and Child's Shark repellent, appeared to have some potential as deterrents when poured directly on baits.

Hunt (1984) also found that Bear Skunker and a Skunker/Halt combination were effective repellents when sprayed on captive bears. However, in tests with wild black bears, Skunker spray repelled bears only 54% of the time

and many of the repelled bears resumed feeding shortly thereafter. Bear Skunker did not appear to have deterrent potential as a passive stimuli (i.e., when poured on or around baits).

Hunt (1984) tested several other chemicals as passive deterrents for free ranging black bears. Male human urine and full strength ammonia were the most effective stimuli. Urine deterred bears 78% and 38% of the time when placed on and near the bait, respectively. Comparable figures for the ammonia were 67% and 56%. Miller (1980) reported that full-strength ammonia did not deter most polar bears from eating when placed around baits; however, when sprayed in the face of captive polar bears, ammonia elicited a strong response. Aversive conditioning experiments in Yosemite National Park which used ammonium hydroxide as a repellent were described previously.

Passive stimuli which did not appear to have deterrent potential (in addition to Bear Skunker and capsaicin, as noted previously) were Boundry (commercial dog deterrent), mothballs, Technichem (potential commercial bear deterrent) and ammonia with a detergent additive (Hunt 1984).

Follmann et al. (1980) briefly reviewed the literature concerning the physiological effects of lacrimating agents (tear gas). He noted that if the dose levels used in some laboratory experiments were achieved in the field, tear gases could injure animals or cause pain. In such a case, the animal could become enraged and more dangerous. Hunt (1984) sprayed a black bear with commercial tear gas (Shield) as it was restrained by a snare. The bear immediately recharged and continued to act aggressively until the tester left the area.

Acoustic Repellents

Considerable literature has been written on the biological effects of sound (see review in Follmann et al. 1980). Much of this material relates to the health effects of man-made sounds or to the use of sound as a deterrent for avian pests. However, several studies of acoustic deterrents and repellents for bears have recently been conducted. Potential advantages of acoustic repellents are that they are nondestructive, require no direct contact between the target bears and the equipment, are effective for moderately long ranges and can be easily interfaced with devices designed to detect intrusion (Wooldridge and Belton 1980).

Two main approaches to using sound as a deterrent exist (Follmann et al. 1980). The first utilizes a sound of the proper frequency (HZ) and pressure level (intensity in dB) to cause pain or discomfort in the target animal (Miller 1980, 1983, in press, Compuheat 1986). The second approach is biosonics, or the use of biologically significant sounds (alarm or aggressive vocalizations), to cause distress in an animal (Miller 1980, 1983, in press, Wooldridge and Belton 1980, Wooldridge 1983).

Wooldridge and Belton (1980) recorded the aggressive sounds of captive polar bears. These sounds were analyzed for their characteristic frequencies and then electronically simulated to test their effect on captive and free-ranging bears. All captive polar (n=5) and brown bears (n=2) except the 2 original sources for the sounds were intensely frightened by the recordings. A heart-rate transmitter implanted in 1 of the polar bears showed increases of 54-180% over normal when various sounds were presented to the bear. In tests with wild black bears (n=13) all responded significantly to at least 1 of the sounds and most reacted strongly to 3 or more of the sounds. All but 1 free-ranging polar bear retreated upon exposure to an effective sound. Wooldridge and Belton (1986) concluded that biologically significant sounds could be effective in repelling nuisance bears. Recommendations for the most effective frequency, amplitude and pattern were provided.

In a later study (Wooldridge 1983), 74 free-ranging polar bears were tested with the same acoustic repellents as described above. Fifty-one were strongly repelled, 8 showed no response and 15 investigated the sound. Wooldridge (1983) felt that the combined effects of a high-amplitude sound (i.e., at the pain or discomfort threshold) plus a biologically significant message could reduce the possibility of habituation to acoustic repellents. Another recent study conducted at Cape Churchill (Compuheat 1986) revealed that polar bears were most sensitive to sounds in the 0.1 - 9.0 kHZ range and were effectively deterred by loud, pulsed sounds in the 1.0 - 4.0 kHZ range.

Miller (1980, 1983, in press) tested the repellent effects of recorded, aggressive polar and grizzly bear vocalizations on captive and free-ranging bears. In lab tests, these recorded sounds were either attractive or induced caution instead of fear (Miller 1980, 1983). However, in 50% of the field tests, polar bears were repelled by the recorded vocalizations. Hunt (1984) reported that taped sounds of a male grizzly bear caused a male black bear to charge and remain aggressive.

The most promising acoustic repellent tested by Miller (1980, 1983, in press) was a hand-held, freon-powered boat horn. Captive grizzly and polar bears were repelled by this device in 81% of 31 lab tests; however, bears were also repelled during 50% of the control (no auditory stimulus) tests. Free-ranging polar bears were repelled by the horn in 81% of 31 field tests but, again, 50% of the control tests elicited an escape response. Hunt (1984) tested the air horn on captive and restrained black bears and concluded that it was not a promising repellent. Tested bears responded to the horn blast with increased aggression. Stenhouse (1983) reported that a loud (115 dB at 1 m) siren was not effective as a polar bear deterrent.

A number of other acoustic repellents have been tested and shown to have marginal or no value as repellents. Miller (1980,in press) found that bells, whistles and shouting humans were not effective repellents (bears repelled in less than 33% of the trials). A loud radio repelled wild polar bears in both of 2 tests. Hunt (1984) reported that a captive male black bear showed a mixed reaction to taped rock-and-roll music.

Stenhouse (1982, 1983) tested the effect of recordings of barking dogs on polar bears at Cape Churchill, Manitoba. In the first field season, 87% of the approaching bears (n=26) were not deterred and in 4 cases, became aggressive. In the second field season, no bears were deterred by the recordings (n=131). However, other researchers reported that the most successful and practical deterrents for protecting work camps from bears were noisy, aggressive well-trained bush dogs (Hamilton and Smith 1981, Yukon Dep. Renew. Res. 1983).

Visual and Explosive Repellents

Several types of visual repellents have been used or tested with bears. Miller (1980, 1983) tested a "loom" stimulus on captive polar and grizzly bears. This stimulus consisted of a 1 x 1.5 m piece of plywood which was rapidly flashed before an approaching bear. The loom consistently repelled or deflected charging bears but the effect was short-lived (about 30 seconds) and bears habituated to it rapidly. Hunt (1984) tested a similar stimulus, a quickly opened umbrella, on captive black bears. Bears responded by becoming aggressive or charging during 63% of the tests.

Flares, thunderflashes and various other pyrotechnic devices have been used as bear repellents. Hunt (1984) reported that captive black bears responded aggressively to flares during 65% of the tests. However, tests of "flare/scare cartridges" at Cape Churchill, Manitoba, showed that these devices did have potential as repellents on free-ranging polar bears (Stenhouse 1983, Stenhouse and Cattet 1984). These flares, designed to scare avian pests from civil and military airfields, emitted a yellow flare trace before exploding to produce a bright white flash. The flares successfully deterred bears from approaching field crews in 77% of the tests (n=58) during the first field season (Stenhouse 1983). In the second (1983) field season, 64% of the bears tested (n=25) were deterred, or viewed in another way, 36% of the bears continued their approach despite the flares. Two marked bears which had been previously deterred using rubber batons (see below) displayed a faster reaction than untested bears when the flare/scare cartridges exploded. These bears may have associated the auditory stimuli (explosion) with the impact of the rubber baton (Stenhouse and Cattet 1984). The researchers concluded that although the flares were not totally effective in deterring polar bears, they were useful because they were reliable, had a long range (120 m) and could illuminate bears in darkness.

Miller (1983) reported that the explosive sounds of a Thunderflash (very loud firecracker) and a Cap-Chur gun (firing a .22 caliber blank) caused captive bears to scramble away from the tester. A propane cannon noisemaker used to frighten a marauding grizzly bear away from a sheep allotment near Yellowstone National Park was only temporarily effective (Matejko and Franklin 1983).

Various types of fireworks (cracker shells) have been routinely used to frighten bears in some areas (Henderson 1982, NPS 1984, Anon. 1984). These types of bear scaring devices may lose their effect after repeated exposure (Yukon Dep. Renew. Res. 1983, B. Bromley 1985).

Projectiles as Repellents

Rubber Batons — 38 mm

Small gauge birdshot and rock salt have been used to repel bears in some areas (Henderson 1982, Jope 1983b, Anon. 1984a), but research to analyze the effectiveness of these repellent methods has not been conducted. However, extensive research has been done, primarily with polar bears, on the use of 38 mm anti-riot rubber batons and 12-gauge slugs as bear deterrents. The Government of the Northwest Territories has been testing these devices at Cape Churchill, Manitoba, since 1981 (Stenhouse 1982, 1983, Stenhouse and Cattet 1984, Derocher and Miller 1986).

Two different models of 38 mm anti-riot batons were tested. Both are cylindrical rubber projectiles wholly or partially sealed in a waterproof aluminum cartridge case. Stenhouse (1982) gives the dimensions and ballistics data for the batons. The batons are fired from a riot gun with a conventional break-open design similar to that of a shotgun.

During 3 years of deterrent research at Cape Churchill, 405 polar bears were tested with the rubber batons (Stenhouse and Cattet 1984). Four hundred and four of these bears were successfully deterred. Testing was discontinued on 1 large, emaciated male after it was hit 5 times without leaving the bait site. A yearling male was killed after being struck behind the left shoulder from a distance of 30-35 m. A necropsy showed that the baton had broken a rib. The cause of death was diagnosed as cardiac tamponade subsequent to filling of the pericardial sac with blood from a rupture in the ventricular wall (Stenhouse and Cattet 1984, Haigh and Stenhouse 1985).

The rubber batons were also used in 22 actual control operations, including 9 cases involving grizzly bears. The field officers firing the batons reported that the effectiveness of the deterrent was "good to very good" although range (about 40 m) and accuracy needed improvement (Stenhouse and Cattet 1984).

Bears struck with the batons responded by flinching, snapping at the impact area, spinning around and leaving the area (Stenhouse and Cattet 1984). None of the animals subjected to deterrent tests displayed any overt agression toward the person firing the batons. Of 42 marked bears tested, 12 (28.6%) were observed to return to the bait site 1 or more times, but these bears displayed much more caution in returning to the bait site than did untested bears.

Stenhouse (1982) recommended that all batons be directed at the chest or hind quarters. Intensive training is required to effectively use the 38 mm anti-riot gun before a fair degree of accuracy is achieved (Stenhouse 1983). Accuracy rates for highly experienced users ranged from 80-89% (Stenhouse 1983, Stenhouse and Cattet 1984). Other drawbacks of the 38 mm batons are short range, single shot capability, cost and the need for a special (38 mm) gun to fire the batons (Stenhouse and Cattet 1984).

Plastic Slugs — 12-Gauge

Several types of plastic projectiles which can be fired from standard 12-gauge shotguns have been tested on black, grizzly and polar bears (Stenhouse 1983, Stenhouse and Cattet 1984, Dalle-Molle 1984B, Derocher and Miller 1986).

Preliminary tests of 12-gauge slugs were conducted at Churchill, Manitoba (Stenhouse 1983, Stenhouse and Cattet 1984). The projectile (SS 200) was a 5 cm, 90 gm, solid, plastic, tapering projectile with 4 tail-fins. These tests showed that the slugs were not highly effective in deterring polar bears from baited sites. Nevetheless, use of the slugs had 3 major advantages over the 38 mm rubber batons: high degree of accuracy, low cost and use of a standard 12-gauge shotgun (Stenhouse 1983).

Wooldridge (1984) and Dalle-Molle (1984) also conducted tests using the SS-200 plastic slug. Wooldridge reported

that the slugs could be accurately placed from a distance of 10 m although accuracy was reduced considerably with moderate cross-winds. When fired at a plywood target, the slugs penetrated to depths of 9 mm and 0 mm when fired from distances of 3 m and 8 m, respectively. Wooldridge concluded that the "range of choice" for the SS-200 slugs was 5 m. Dalle-Molle (1984) found that when fired at carcasses from 20 m, the slugs sometimes penetrated hide, fat and flesh to a depth of several millimeters.

Wooldridge (1984) tested the SS-200 slugs on 23 identifiable black bears as they fed on garbage at a dump site. All of the bears were repelled by the slugs; 91% immediately ran into adjacent woods. However, 38% returned to feed at the dump including 4 within 24 hours and the others within 7 to 9 days. Dalle-Molle (1984) tested the SS-200s on 2 grizzly bears and 1 black bear for a total of 6 trials. These bears, which had succeeded in obtaining food from a camp, were shot at from an average distance of 24 m as they approached test camps. All the bears immediately ran 15-100 m after being shot, but reapproached test camps from 2-59 days later.

Following the initial tests at Churchill, a number of prototype slugs were produced (using heavier projectiles and a variety of powder charges) to provide similar impact velocities to the 38 mm batons at distances of 35-40 m. These prototypes were tested on bear carcasses to evaluate their impact. Since these cartridges broke the hide and penetrated the flesh, they were deemed unacceptable for use on live bears (Stenhouse and Cattet 1984).

A subsequent study at Churchill evaluated the repellent capabilities of the heavier (125 gram) "Bear Deterrent Round" prototypes on polar bears. A total of 119 trials were completed, including 77 bears hit with the rounds and 42 control animals. Test bears were hit an average of 2.14 times per trial indicating that a single hit was not a sufficient deterrent. Eighty-seven percent of the marked bears returned to the bait site 1 or more times with an average return time of 17 hours. None of the bears hit showed any signs of injury. The overall accuracy of the shells was high: 89% from an average distance of 24 m. The maximum effective range was 20-25 m. Shell drifting of 0.5-1.5 m was common at distances of 25 m or greater in moderate wind.

The studies cited above indicated that the 12-gauge plastic slugs show some promise as a bear repellent. However, an effective 12-gauge shell with the necessary impact and accuracy has yet to be developed (Hunt 1985, Derocher and Miller 1986).

Other Projectiles

Jonkel and Klassen (1985) studied the tissue impacts of the "Bear Thumper" — a modification of the "stun gun" designed by Mountain Scent Research. The projectiles used were 20 cc plastic bottles filled with low tension latex or water. These projectiles were tested because the stun gun's standard rubber projectile was expensive, easy to lose and became very hard when cold. Two shots were fired at a captive bear from 1.8 and 3.5 m away, respectively. These shots were directed at each side of the rib cage to test the effects of the projectiles hitting a vulnerable (thoracic) area from closer than recommended range. Necropsy revealed that the projectile inflicted no serious organ damage although some cutaneous and sub-cutaneous bruising and minor muscle separation were noted.

Stenhouse (1983) tested the effectiveness of darting polar bears with tetracycline as a deterrent method. All bears darted were deterred. However, Stenhouse concluded that logistical difficulties in preparing and handling the powder charges, injection fluid and syringe darts rendered this method unsatisfactory as a deterrent technique.

Bear Attractants

Very little research has been done on identifying and studying particular bear attractants. The problem of garbage as an attractant is discussed in a subsequent section.

A link between human menstruation and bear attacks has been the subject of much speculation (Natl. Park Service 1967, Herrero 1985). Cushing (1983) studied the responses of polar bears to human menstrual odors. In laboratory experiments, used tampons elicited a "maximum behavioral response" similar to the stereotypic response to seal scents. Polar bears also responsed to the presence of a human female but the response was less strong than that to the seal or menstrual scents. In field tests, bears detected (usually by scent) and consumed food scent samples and used tampons,but ignored non-food scents (castoreum, musk, manure) and human blood. These findings suggested that some factor in menstrual fluid other than blood was responsible for the attraction. In his analysis of grizzly bear inflicted injuries, Herrero (1985) did not find a correlation between attacks on women and stage of menstrual cycle; however, he noted that the data for this analysis were very incomplete.

Miller (1980) found that bells of the type generally sold to hikers to warn bears of their approach sometimes attracted captive bears. One bear slept through 2 tests as the bear bells were sounded from 6 m away. Jope (1982, 1984, 1985) evaluated the effectiveness of bear bells as part of her analysis of grizzly bear/hiker interactions in Glacier National Park, Montana. She found that hikers who wore bells did observe bears at closer distances than those without bells, but she attributed this to possible overconfidence of the bell-wearers and their tendency to be less observant than non-bear wearers. In addition, more bears which were not moving when initially observed moved away from hikers with bells than from hikers without bells (67% vs. 26%). Other data also suggested that bear bells were an effective protection device and not a dangerous attractant.

POPULATION AUGMENTATION

The encroachment of human activities into areas formerly occupied by the grizzly bear have resulted in range fragmentation and insularization of certain subpopulations. Once the number of bears in these isolated populations become very low, the grizzly's low reproductive rate and various demographic aberrations may interfere with "natural" recovery. Such populations may also be extremely sensitive to any new mortality factors or major habitat disturbances. In these cases, population augmentation may be required to ensure the long-term survival of the grizzly bear in isolated areas (Servheen et al. in press, USFS 1985ag). Augumentation differs from reintroduction in that the former involves the transplanting of bears to

bolster small extant populations while the latter involves attempts to reestablish grizzlies in areas from which they have been extirpated (Servheen et al. in press).

Population augmentation has both demographic and genetic advantages for the recipient population. Demographic advantages include the direct contribution from the addition of the transplanted bear to the ecosystem and the contribution to future reproduction and population growth in the augmented population (Maguire 1985). The genetic problems associated with population isolation were discussed in a previous section. The introduction of bears from outside the target ecosystem can help to avoid the deleterious effects of excessive inbreeding in small populations (Servheen et al. in press).

Augmentation Methods

Two methods of augmentation have received serious consideration (Servheen et al. in press). The first method involves transplanting grizzlies of a predetermined, optimal, age, sex and behavioral history from a high density (donor) to a low density (target) area. The second method involves the cross-fostering of captive-reared grizzly bear cubs to resident black bear females in the target area. The most promising cross-fostering method is placement of grizzly cubs inside black bear natal dens prior to emergence (Servheen et al. in press). Other augmentation methods, including placement of cubs with post-emergence lactating females and the release of single cubs into the wild, have been successful with black bears and grizzly bears (Jonkel et al. 1980, Alt and Beecham 1984). However, since these methods involve older cubs and greater opportunity for habituation to humans, they are much less desirable than the natal den approach. Servheen et al. (in press) provided detailed scenarios of the 2 preferred augmentation methods.

Success of an augmentation effort can be interpreted from either a short- or long-term basis. Proximate success may be judged by retention in the target area for 2 years without conflicts (Mace and Haroldson 1984, Maguire 1985). For cross-fostering augmentation, successful weaning of the grizzly cub followed by retention in the foster mother's home range and successful denning defines short-term success (Servheen et al. in press). Long-term success for either method requires that the transplanted bear enter the target population as a reproducing adult (Servheen et al. in press).

Selecting Suitable Age/Sex Class and Area for Augmentation

The probability of success for a particular augmentation effort may depend largely on the age/sex class of the transplanted bear. Maguire (1985) employed the principles of "decision making under uncertainty" to identify the optimal age/sex class(es) for a hypothetical augmentation effort in the Cabinet-Yaak ecosystem. Her analysis revealed that maximizing the benefit to the target population (through the reproductive value of the bear) while simultaneously minimizing the probability of conflict or "wasting" of transplanted bear (due to mortality or failure to remain in the target area) was a difficult exercise. The analysis incorporated both objective and subjective evaluations of reproductive value, conflict potential and retention for 16 different augmentation categories. A computer simulation model was later employed to futher refine these values. The major conclusion of the study was that young (4-6 yr. old) female bears were the best candidates for successful augmentation. This agrees with Mace and Haroldson's (1984) earlier results. Female cubs were also preferred for cross-fostering augmentation (Servheen et al. in press). If "optimal" ages were not available, any of the female age classes would be acceptable. Male bears of any age class were poor prospects for translocation. August was considered the best time for augmentation since bears tended to be more sedentary in August than at other times of the year. Even under optimal conditions, the probable success rate of translocated bears was fairly low. Additional research was suggested to examine the costs and benefits of augmentation to the donor population, the mortality rates used in the analysis and the public relations and education aspects of augmentation. Osmundson (1983) encountered significant public opposition to the 1981 translocation of 2 bears into the Cabinet-Yaak ecosystem. It is noteworthy that in that attempt, the age/sex of the 2 bears (yearling males) and season of the transplant (Spring) were those deemed least desirable by Maguire's (1985) analysis.

Age/sex class and season are not the only factors to be considered prior to initiating an augmentation effort. Servheen et al. (in press) noted that the history of the bear in relation to man is of vital concern. Bears with a previous history of positive attraction to humans or human use areas are not suitable for augmentation. When information on the individual bear is lacking, inferences should be based on the type of human activities occurring in the donor area.

The donor area should be topographically and vegetatively similar to the target area to enhance retention and probability of successful adjustment of the transplanted bear to the target area. Mace and Haroldson (1984) outlined the habitat features which should be comparable in the 2 areas.

No legitimate tests of the augmentation strategy have been undertaken to date although serious consideration is being given to population augmentation for the Cabinet-Yaak ecosystem (Maguire 1985, Servheen et al. in press). Seven different grizzly bears were added to the Cabinet-Yaak ecosystem from 1980-1985 but none were known to remain in the target area by 1985. All of these bears were nuisance relocations and none were selected according to the criteria previously outlined (USFS 1985ag). Although the biological questions concerning grizzly bear population augmentation are not fully resolved, the most formidable obstacles confronting augmentation efforts may be social and political.

RELOCATION OF NUISANCE BEARS

Translocation of nuisance bears has been a common management tool since the 1950's (Taylor 1984). Most North American park management plans include provisions for translocating grizzlies which have entered developed areas or demonstrated some form of undesirable behavior. The Bear Management Plan for Glacier National

Park, Montana (NPS 1985a) calls for relocation of "habituated" bears (those accustomed to frequenting developed areas but not overly familiar with humans). "Conditioned" bears (those obtaining non-natural foods, destroying property or displaying unnatural aggressive behavior) are destroyed or relocated outside the park. A set of guidelines helps to standardize the decision making for different settings and conflict situations.

In Yellowstone National Park, bears which have obtained food in campgrounds or developed areas or which persistently frequent frontcountry areas are candidates for relocation. In the backcountry, bears are relocated only if they become unnaturally aggressive or if there are no other means to provide for human safety (NPS 1984a,1985b). From 1968-83, 272 grizzly bear relocations were performed in Yellowstone National Park (NPS 1985d). Greer (1968-1985) and Roop (1975-1983) provided relocation data for portions of the YGBE in Montana and Wyoming, respectively.

Elsewhere in the contiguous United States, specific guidelines have been developed for determining grizzly bear nuisance status and prescribing appropriate control actions (Anon. 1979, Mealey 1979, Servheen et al. 1981, Dood et al. 1986). In general, these guidelines recommended either relocation or removal according to conflict severity (e.g., depredation, aggression, human injury), number of offenses, age/sex class and reproductive status of the grizzly.

Taylor (1984) reviewed the bear management plans in Canadian national parks. He found that beginning in the mid 1950s, when culvert traps first enabled the live-trapping of bears, translocation has been a preferred bear management procedure. Mundy and Flook (1973) reported that a minimum of 19 grizzly bears were relocated in the Canadian mountain parks from 1963-68. Beginning in the mid-1970s, park managers began to recognize that control of human activity must be the foundation of a successful bear management program and that destroying, capturing and translocating bears were undesirable management actions to be minimized (Taylor 1984). However, translocation of nuisance bears continues to play a major role in park management programs. In Jasper National Park, 56 and 48 bears (species not specified) were relocated in 1980 and 1981, respectively. In Banff National Park, 70 and 15 bears were relocated in the same years. The Waterton Lakes National Park Bear Management Plan allows for up to 3 relocations per bear unless the animal is particularly aggressive. No diseased or otherwise infirmed bears are to be relocated and females with cubs are given special consideration.

Leonard et. al. (1983) reviewed the bear management procedures in the prairie region national parks and historic sites of western Canada. In Kluane National Park, bear management emphasized preventative measures and grizzlies were to be relocated only once before being destroyed. Nahanni National Park planned to trap and relocate nuisance grizzlies once helicopter support became available.

The Alberta Provincial Parks Bear Conflict Prevention Programme (Alberta Recreation Parks and Wildlife 1978) states that persistent nuisance bears are to be live-trapped and translocated. Grizzly bears are to be translocated rather than destroyed except when dictated by consideration of immediate visitor safety or injury. The Alberta Fish and Wildlife Division translocated 24 grizzlies in the province during the 1970s (Gunson 1981).

In Denali National Park, grizzly bears are relocated only after all experimental aversive conditioning efforts have failed to alter the undesirable behavior. A bear may be destroyed after 2 unsuccessful relocation attempts or when involved in a non-defensive, unprovoked attack on humans (NPS 1984a). Twenty-seven grizzly bear relocations were preformed within the present boundaries of Denali National Park from 1946-82 (Buskirk and Johnson 1976). In Katmai National Park, nuisance bears are handled by eviction from the conflict area, "peppering," monitoring of activity and, if the nature of the offense warrants, by destruction. No provisions for relocation were included in the 1984-85 management plan (Anon 1984a).

Homing

Grizzly bears have demonstrated an impressive ability to home to familiar territory following relocation attempts. Haroldson and Mace (in prep.) provided a general discussion of the homing instinct in bears. A few of the more noteworthy examples of grizzly bear homing are discussed below.

Pearson (1975) reported that 1 young sow which was translocated twice returned 32 km in 22 days after the first release and 75 km in 5 days after the second. Another sow was translocated 113 km and returned to her captive site after only 3 days (Pearson 1972). In Yellowstone National Park, 1 grizzly sow returned 54 km in 62 hours after her first relocation and 85 km after a second relocation. One male returned 43 km in 1 week and another covered 50 km in 4 days (Craighead 1976). Judd and Knight (1980) reported that a 5-year-old male successfully denned near the release area after relocation but the following summer he covered at least 153 km to return to his earlier home range.

Perhaps the most remarkable case of homing was described by Miller and Ballard (1982b). A subadult male brown bear was transplanted 93 km by boat to an island in Prince William Sound, Alaska. The bear managed to return to its capture site 28 days later. Depending on which of 2 possible return routes the bear actually followed, he swam 15.1 or 10.5 km across strong tidal currents to reach his destination. Based on their observations of 29 translocated brown bears in Alaska, the authors concluded that homing was not the result of random movements until familiar terrain was encountered. Their observations on post-release movement directions (discussed below) supported this finding.

Criteria for Evaluating Relocation Success

The criteria used to define "success" of relocation attempts have varied widely between studies. Aune and Stivers (1981) noted that unless a relocated bear participates in another breeding season, no contribution has been made to population perpetuation and the management agency often absorbs considerable expense for aborted relocation attempts. Since most relocations are undertaken to achieve spatial separation between a nuisance bear and a conflict-attractant, many managers have considered relo-

cations a success if there is no further nuisance behavior for the remainder of the season (Cole 1971, J.J. Craighead and F.C. Craighead, Jr. 1972, Meagher and Phillips 1983) or for longer periods (Thier and Sizemore 1981, Haroldson and Mace in prep.).

Success Rates and Transplant Distance

Sixty-eight percent of 145 translocation attempts in Yellowstone National Park from 1959-69 were unsuccessful in that the translocated grizzlies returned to the same or another development (J.J. Craighead and F.C. Craighead, Jr. 1972). The percentage of relocated bears which returned in each distance class were as follows: 0-16km, 71%; 16-33km, 70%; 32-48km, 60%; 48-64km, 25%.

Cole (1971, 1972, 1976) and Meagher and Phillips (1983) also evaluated the success of relocation efforts in Yellowstone National Park. The percent of successful relocations (i.e., no further conflict in the same year) ranged from 33% in 1968-69 to 100% in 1979 (only a single grizzly was relocated that year). All other years had success rates of between 57-80%. In 1968-69, when success rates were lowest, grizzly bears which returned from transplant sites were moved a maximum of 45km (Cole 1972).

Thier and Sizemore (1981) reviewed the 1975-80 grizzly bear relocation data for the Northern Continental Divide ecosystem. A "successful" relocation was 1 for which the relocated bear did not return to the capture area or come into any further conflict during the 5-year analysis period. By this definition, 62% of 26 relocations were successful. The distance moved was the most important factor determining the success of relocations. Bears were moved from 19-272 km. All relocations greater than 120 km were successful while 44% of those less than 120 km were successful.

Mace and Riley (in prep.) also analyzed relocation data for the Northern Continental Divide ecosystem. They found that 56% of 45 relocation attempts successfully deterred further conflict for at least 2 years. Bears were moved mean distances of 119 km and 90 km in successful and unsuccessful attempts, respectively. Martinka (1982a) reported that 9 out of 16 (56%) of the grizzly bears relocated within Glacier National Park from 1966-81 successfully avoided further conflict. The distances of these relocations were not provided.

Miller and Ballard (1982b) studied the homing behavior of 29 brown bears transplanted in southcentral Alaska as part of a moose mortality study. A bear was treated as a "return" when it arrived within 1.2 average home range diameters (32.4 km) of its capture site. By this criterion, 12 of 20 (60%) adults returned to familiar territory. The researchers noted that the success rate in their study would probably exceed that for most relocations since they were dealing with non-nuisance bears. Relocation distances for these bears averaged 198 km (range of 145-255 km) and average return time was 58 days (range of 13-133 days). Non-returning bears were transplanted further than returning bears. Eight non-returning adults were moved an average of 233 km (range of 168-286 km).

The movement rates and directions of transplanted bears were also examined. Returning bears had greater movement rates ($x = 3.6$ km/day) while in route than following their return ($x = 0.6$ km/day) or than non-returning bears ($x = 1.4$ km/day). Returning bears moved in a homing direction for 87% of the distance between sighting, whereas, non-returning bears moved in a homing direction for only 39% of the distance between sightings. Spreadbury (1984) also found increased movement rates for 2 translocated grizzlies for 10 days following release.

Relocation Factors

Age/Sex Factors

A number of studies documented age or sex class differences in success of relocations. Pearson (1975) felt that for successful relocations, native male grizzlies should be moved at least 161 km while mature females should be moved 81 km. Thier and Sizemore (1981) reported that from 1975-80, 80% of the female relocations in the Northern Continental Divide ecosystem were successful as compared to 36% of the male relocations. However, females were relocated at significantly greater distances than males and, as noted earlier, distance was the most important factor in relocation success. Relocations of subadult males were significantly more successful than those of adult males. There was no apparent difference in relocation success between female age groups. Younger age classes (both sexes combined) had high probabilities of success; 7 relocations of bears less than 2.5 years of age were all successful. Martinka (1982a) reported that 7 of 9 successful relocations inside Glacier National Park from 1966-81 were subadults or cubs. Mace and Riley (in prep.) examined Northern Continental Divide relocation data for 1975-84. As in the above study, female relocations were more successful than male relocations (65% and 43%, respectively) but this difference was not significant. Age class differences in success rates were minor: 57% for adults, 59% for subadults and 54% for cubs.

In Miller and Ballard's (1982b) Alaskan brown bear study, there was no significant difference in the incidence of return between the sexes. However, female bears took longer than male bears to return to the capture site (72 vs. 24 days). The mean age of returning males (10.0 years) was significantly greater than that of nonreturning males (4.8 years) when hunter killed bears were excluded from the analysis. There was also a significant difference in the mean of returning (8.8 years) and non-returning bears (5.3 years) when data for both sexes were combined. There was no threshold age below which bears would not return.

Reproductive Status

Miller and Ballard (1982b) stated that reproductive status was not a factor in determining whether or not a female brown bear returned. Females in estrus and females with offspring were included in both returning and non-returning groups. However, only 3 of 9 young transplanted with 5 radio-collared females were still with their mothers when last observed. The missing young were suspected mortalities. The homing movements of females with young appeared to be more influenced by natural or man-made barriers than was observed for other bears. Two of 5 adult bears deflected by a major river and all 3 of the bears deflected by a highway were sows with young. There was also some indication of reduced productivity by transplanted females in the year following transplant.

Topography

Miller and Ballard (1982b) found that 5 bears which appeared to be returning to their capture area reversed directions after intersecting the Copper River. Two of these bears eventually crossed the river. As noted previously, 3 females with young were temporarily deflected by a major highway. Spreadbury (1984) also reported that the travel routes of a grizzly sow and yearling were deflected by a highway. In both of these studies, the grizzlies later overcame the aversion and crossed highways.

Bear History and Type of Offense

Cole (1971,1972) stated that the excessive number of control actions in Yellowstone National Park from 1968-70 was due in part to inadequate control in previous years. He concluded that repeated transplants of bears which habitually frequented developed areas was ineffective and placed bear control on a "sustained yield" basis. Improved success by 1971 was attributed in part to selective removal, rather than relocation, of bears which had prior experience in returning from transplants (Cole 1971). Examination of the Yellowstone relocation data for 1970-79 (Meagher and Phillips 1983) indicated that 31% of 147 grizzly bear relocations were repeat transplants.

While the literature was replete with instances of bears repeating their nuisance behavior following relocation, only 1 study examined this issue in depth. Thier and Sizemore (1981) analyzed relocation success by type of offense leading to the relocation attempt. Bears involved in livestock depredations and cabin break-ins were negatively correlated with success while relocations of bears captured after coming into proximity with campgrounds or residences were significantly more successful. Surprisingly, association with garbage was not a significant factor in relocation success. The researchers postulated that the aggressive nature of the depredation and break-in offenses contributed to the poor success rate. Sample sizes for all offense types was small (n=3-10).

Season of Transplant

Thier and Sizemore (1981) found that summer relocations were significantly less successful than relocations in the other seasons. However, the non-successful summer relocations all involved depredation and property damage, offenses which were negatively correlated with success. A regression analysis indicated that individual seasons did not significantly contribute to relocation outcome. Maguire (1985) concluded that grizzly bears transplanted for population augmentation would be less likely to vacate the target area in August than in spring when bears ranged more widely in search of patchily distributed forage items.

Stress from Relocation

Several studies found evidence of increased stress or vulnerability to mortality factors following relocation. Russell et al. (1979) recorded a 43 kg weight loss for a transplanted male grizzly which was recaptured 23 days after the transplant. Miller and Ballard (1982b) found evidence suggesting reduced reproductive performance by transplanted female brown bears. Greer (1976a) reported that in 1971, when 17 bears were translocated in the Yellowstone ecosystem (excluding Yellowstone Park), 9 were legally killed by hunters in that same year.

Spreadbury (1984) postulated that increased post-release movements (as were also documented by Miller and Ballard 1982) through unfamiliar terrain increased the stress level of transplanted bears. A dart-induced wound on a grizzly yearling which he monitored had failed to heal 4 months after its capture and relocation. He interpreted this as possible physiological evidence for elevated stress although he notes elsewhere that both bears appeared to be in excellent physical condition when killed.

Spreadbury (1984) also observed that the movement patterns of recently translocated bears could increase the likelihood of human conflict. This could arise from either chance encounter with attractants or physiological stress. He noted that the 2 translocated grizzlies in his study had probably experienced minimal human contact prior to release since the area of the Yukon where they were trapped was remote and lacked much recreational activity. However, both grizzlies were killed after breaking into a meat cache less than 4 months after their release.

Conflicts with resident bears could cause increased stress or abandonment of the release area by the translocated bears. Pearson (1975) recommended that bears be released where there were no resident grizzly bears since intraspecific encounters might cause translocated bears to seek their original home range. Stokes (1970) observed that relocations were less likely to succeed if release areas already included high numbers of bears. Because introduced "newcomers" would be disadvantaged relative to resident bears, he suggested that transplanted bears might be best used to reestablish grizzlies in remote areas without resident bears. However, other researchers concluded that nuisance bears would be ill-suited for this purpose (Haroldson and Mace in prep.)

Habitat and Food Availability

Haroldson and Mace (in prep.) suggested that grizzly bear augmentations had a higher possibility of success if habitat variables were similar between the capture and release areas. Presumably, a bear should be better able to exploit the habitat at the release area during the critical post-release period if this habitat is somewhat comparable to the bear's familiar home range. They noted that the abundance and diversity of natural foods at the release site could be a major factor in determining the success of a relocation.

Spreadbury (1984) experimented with the use of feeding supplements to induce a bear to remain in the release area. One whole and 2 halves of black bear carcasses were air dropped within 100 m of a translocated grizzly sow and yearling but the bears failed to use the carcasses. The researcher speculated that placement of carcasses in the release area prior to release might be more effective. Pearson (1975) also suggested that some type of habitat manipulation might entice relocated bears to remain at release areas.

Thier and Sizemore (1981) recommended that prior to release, the area within a 20 mile radius of the release area should be surveyed for potential conflict sites. Conflicts of the same type as the 1 for which the bear was captured were of primary concern as their data suggested that grizzlies tended to specialize at a single kind of offense. Haroldson and Mace (in prep.) similarly recommended that a conflict-

free buffer zone should surround release areas. Most national park bear management programs stipulated that release areas be remote from potential conflict areas (NPS 1984a, 1985b, Parks Canada 1984).

Aversive Conditioning Prior to Release

In an attempt to improve the probability of success for relocations of nuisance grizzlies, some researchers have experimented with pre-release aversive conditioning (Servheen 1977ab, Jonkel 1982b, 1983). Aversive conditioning techniques were discussed in a previous section.

Conclusions

Research has indicated that relocation can be a moderately effective management tool when properly applied. As Taylor (1984:292) noted "one might consider capture attempts, relocations or destructions as a reactive style of management that usually reflects a failure in one or more of the other program elements." Pearson (1975) observed that translocation could be most useful in temporarily relieving pressure and conflict until human activities leading to the problem could be remedied.

The preceding discussion further indicates that the following factors contributing to the probability of relocation success should be considered in management actions:

1. Suitable relocation distance as determined by:
   a. age/sex class of the bear
   b. usual home range sizes in the release area
   c. habitat characteristics, topography
2. Type of offense and history (number of previous relocations or offenses) of the bear
3. Characteristics of the release area including:
   a. habitat similarity to capture area
   b. food availability and diversity
   c. potential conflict zones within release area and surrounding buffer zone
   d. number of resident bears already present
4. Experimental manipulations which may improve relocation success but need further research including:
   a. pre-release aversive conditioning
   b. food supplements in release area

REINTRODUCTION OF GRIZZLIES INTO FORMER RANGE

Very little information was available in the literature concerning the reintroduction of grizzly bears into areas from which they have been extirpated. For purposes of discussion, reintroduction is distinguished from population augmentation in that the former involves transplanting of bears into ecosystems where there are either no grizzlies or occasional unverified transient grizzlies only (no resident breeding bears). Reintroduction has been considered for several areas but, judging from the literature, there are no plans to reintroduce grizzlies to any portion of their former range in the foreseeable future.

Alaska

The Alaskan "species management policies" (Anon. 1980) states that transplanting of brown/grizzly bears for restocking of former ranges is usually not feasible, but could be a useful management tool under certain conditions. Transplants of this type would be considered only when substantial resource or public benefit could be shown and the following qualifications were met: 1) sufficient habitat was available to support a viable population; 2) no adverse effects on resident species or conflicts with humans would occurr; 3) incompatible land uses would not occurr and 4) future public use of the resource would be guaranteed.

American Southwest

In 1973, the New Mexico-Arizona section of the Wildlife Society passed a resolution encouraging the U.S. Forest Service to prepare management and contingency plans for the reintroduction of the grizzly bear into the southwest (Brown 1985). A study to evaluate the suitability of the Gila Wilderness as grizzly habitat was initiated soon thereafter by Erickson (1974) under contract to the U. S. Forest Service. He concluded that the area was sufficiently large to satisfy the spatial, food, cover and denning requirements of a small population. He felt that overall, the Gila Wilderness was equivalent in habitat attractiveness to areas in the Northern Rockies with extant grizzly populations. Although the core of the wilderness area appeared adequate for reintroduction, Erickson noted that conflicts with other uses, especially livestock grazing, was a "near certainty." The availability of garbage from recreational or other sources was also of concern. The researcher reasoned that with appropriate management such as reduction of grazing in bear high-use zones and control of nuisance bears, these conflicts could be suppressed. If reintroduction was given further consideration, Erickson suggested that the introduced grizzlies should be taken from southwestern or Mexican stock. If no bears of this descent were available, other stocks could be used but bears from populations subjected to some prior harassment or control were preferrable.

The prospect of reestablishing a small grizzly population in the Gila Wilderness was opposed by the cattle industry (Brown 1985). Apparently the social and political climate remains nonconducive to reestablishment of the grizzly in the Southwest. When asked if they would be willing to accept relocated grizzly bears from Montana, the directors of the state game departments in New Mexico and Arizona both responded that they did not anticipate any reintroductions in their state in the foreseeable future (Dood et. al. 1986). The Arizona director added that he perceived no interest by either the game commission or the public favoring reintroduction of the grizzly.

Colorado

The last confirmed grizzly bear in Colorado was killed near the Navajo River in the San Juan Mountains in 1979. Prior to that time, there had been no confirmed grizzly kills

or sightings in Colorado for 25 years (Brown 1985). Surveys and trapping efforts conducted in the south San Juan Mountains in 1981-1982 failed to provide conclusive evidence of grizzly bears in Colorado (Mace 1982, Seitz 1983). In 1982, the Colorado Wildlife Commission unanimously adopted a resolution declaring its opposition to reintroduction of the grizzly into Colorado (Anon. 1982). The resolution cited management problems and conflicts with huntable species, livestock and humans as the basis for the opposition.

North Cascades Ecosystem

The status of the grizzly bear in the North Cascades ecosystem of Washington is uncertain. The last confirmed grizzly bear in the area was killed in 1967. There have been unverified reports of grizzlies in the Cascades each year since then (Bjorklund 1980, Sullivan 1983). Bjorklund (1978,1980ab) investigated the feasibility of reestablishing a grizzly population in the North Cascades National Park complex. His conclusions were similar to those of Erickson (1974) for New Mexico. Spatial and habitat attributes of the area were probably adequate to support a grizzly population, however, the 5 secure (low visitation) zones identified by Bjorklund (1978) were segmented by areas of high human use. Only one of the 5 zones was sufficiently large to provide satisfactory isolation from conflict.

The North Cascades ecosystem is contiguous with a small, low-density grizzly bear population in southern British Columbia (B.C. Ministry of Environment 1979ab). Failure of grizzlies from that area to disperse and establish a resident breeding population in the North Cascades could be construed as evidence of unfavorable conditions for the grizzly in Washington. However, the British Columbia population has only been given total protection since about 1975 and this may have been insufficient time for recovery and dispersal into Washington (Bjorklund 1980a).

A preliminary meeting in 1979 among federal, state and provincial biologists and managers indicated that reintroduction of the grizzly into the North Cascades was worthy of further consideration (Bjorklund 1980a), however, there are currently no plans to reintroduce grizzly bears into Washington. The Washington Dept. of Game is currently planning and developing an assessment of the North Cascades as grizzly bear habitat. A recovery plan for the North Cascades Ecosystem is also being developed. Augmentation will be considered as a management tool depending on Ecosystem needs and the political climate of the area (Hickman pers. commun.).

Selway-Bitteroot Ecosystem

The Selway-Bitterroot ecosystem (SBGBE) of Idaho and Montana is another area where a once abundant grizzly bear population has been severely depleted or eliminated. Factors contributing to the disappearance of grizzlies from the Selway-Bitterroot ecosystem by the 1950s included fire suppression, loss of the anadromous salmon fishery and conflicts with livestock (Davis et. al. 1979). Changes in fire and range management policies in recent years have substantially improved the habitat capability and security of the Selway-Bitteroot ecosystem (Davis et al. 1986). Habitat surveys in the Selway-Bitterroot Wilderness Area indicated that superior habitat was available in this ecosystem (Scaggs 1979, Butterfield and Almack 1985). Davis et. al. (1986) concluded that, of the 6 ecosystems identified in the Grizzly Bear Recovery Plan (USFWS 1982a) "central Idaho may offer the largest contiguous area of land in which to recover a viable population of grizzlies without escalating major conflicts." The Recovery Plan states that, due to the paucity of baseline data available for the Selkirk Mountain, Selway-Bitterroot and North Cascades grizzly bear ecosystems, and the high cost of collecting data in these areas, recovery efforts should be focused on the other identified ecosystems.

Melquist (1985) reviewed the history and current status of the grizzly bear in the Clearwater National Forest of Idaho. Based on an analysis of 88 grizzly bear observations from 1900-1984, he concluded that a few grizzly bears probably occupy, at least temporarily, portions of the Clearwater National Forest and adjacent areas. Melquist also noted that suitable travel corridors existed which could conceivably enable grizzlies to disperse from the Cabinet-Yaak ecosystem south into the Bitterroot Range. This scenario is comparable to that previously discussed for the North Cascades ecosystem in that the seed population is itself "unrecovered" (USFWS 1982a). Given that a few grizzlies may occasionally occupy both the North Cascades and Selway-Bitterroot ecosystems, it becomes a question of semantics as to whether transplanting of grizzlies into these ecosystems constitutes augmentation or reintroduction.

The Idaho Department of Fish and Game has adopted the position that grizzlies may be relocated inside Idaho as necessary (including possible between-ecosystem transplants) but no grizzlies will be accepted from other states (correspondence in Dood et al. 1986, J. Beecham pers. commun.). There are no plans pending to reintroduce grizzlies into Idaho.

Mexico

Grizzlies were once common in the breaks and chaparral of northwestern Mexico. The last known grizzly in the Sierra Madre range was killed in 1932 (Leopold 1967). In 1957-1961, field parties from the Museum of Vertebrate Zoology (University of California) found abundant evidence of grizzlies in the Sierra del Nido mountain range of central Chihuahua. After a series of cattle depredations in 1961, this small grizzly population (up to 30 bears) was subjected to a vigorous poisoning campaign. Two surveys to determine the status of the Mexican grizzly bear in 1968 and 1979 failed to verify the presence of grizzlies in the Sierra del Nido (Koford 1969, Lee and Thier 1979). However, unconfirmed reports suggest that some grizzlies may still roam this range (Lee and Thier 1979, Trevino 1981). There was no mention in the literature of plans to reintroduce the grizzly into any portion of Mexico.

Reintroduction Techniques

The techniques discussed previously for population augmentation would presumably apply to reintroduction as well. There are, however, several additional considerations.

Bjorklund (1978) notes that the age and sex of introduced bears must be selected to achieve a viable demographic

structure. Demographic considerations would have to be balanced with the suitability criteria (likelihood of avoiding conflict and remaining in the transplant area) discussed by Maguire (1985). The history and genetic attributes of the seed population might also influence the success of a reintroduction attempt (Erickson 1974, Brown 1985).

Because proposed reintroduction actions are certain to generate controversy, a major public education program is essential for a successful reintroduction effort (Bjorklund 1980a). Brown (1985) noted that timing and proper planning would be essential to achieve public support for reintroduction of the grizzly into the American Southwest, as the opportunity would probably present itself only once. One vital phase of the planning process would be an in-depth habitat analysis of the proposed reintroduction area. Although there are many unknowns concerning grizzly bear movements and distribution, detailed habitat data could be used to predict grizzly bear distribution and anticipate probable conflict zones.

Craighead (1982) perhaps best summarized the status of the reintroduction issue: "the requisite technology is available; the legal, social, political, economic and philosophical requirements are not."

METHODS FOR ESTIMATING POPULATION SIZE AND TRENDS

Harris (1986a) recently completed a comprehensive review of techniques for determining population size and trends. Much of the following discussion was derived from Harris' work and the reader is referred to his report for a more detailed treatment of these topics.

Certain characteristics of grizzly bears make population estimation difficult (Reynolds 1976, Hebert et al. 1983, Harris 1986a). These are:

1. Grizzly bear behavior, habitat use and foraging patterns make them difficult to observe.
2. Individual bears and different age/sex classes may have different probabilities of capture or observability. This violates the assumption of equal capture probability required by most estimation methods.
3. Because of low population densities, large home ranges, low harvest rates and inherent difficulties for capture or resighting, sample sizes available for population analyses are typically small.
4. Concentrations of grizzlies where food density is high (e.g., salmon spawning areas, huckleberry patches) may make bears easier to count but:
    a. the attractiveness of these areas may vary annually according to productivity/availability of forage items
    b. the timing of peak attractiveness may vary each year, thus, requiring that the bear survey coincide with the same phase of the aggregation each year
    c. some individuals or age/sex classes may be less likely to interested in these gatherings
5. Age/sex classes are difficult to determine without direct handling.
6. Black bears and black bear sign can be mistaken for grizzly sign where both species occur in close proximity.

Methods for estimating population size and trends were placed into the following categories (based partially on the divisions used by Harris 1986b), and are presented in detail in the section below;

1. second-hand reports
2. harvest data indices
3. surveys using tracks and other bear sign
4. bait and scent stations
5. surveys without marked bears: direct counts and general censuses
6. mark-recapture studies
7. population modelling.

Second Hand Reports

Reports of grizzly bear sightings may be extracted from existing material (e.g., ranger logs, journals) or actively solicited (e.g., questionnaires). These can be used to assess general distribution, or, if the records span several years and represent a uniform sampling procedure, to determine population trends. The National Park Service has maintained a computerized storage and retrieval system for a number of years (NPS 1982, J. Smith 1983). Other systems have been developed (or suggested) to assemble information on bear occurrence and activity for several areas (e.g., Leonard 1983, Taylor 1984, Hickman 1985, Claar et al. in press). Keating (1983, 1986) derived a standardized sighting index based on the number of grizzly bears sighted per kilometer traveled as reported in Glacier National Park ranger station logs. Results from his study correlated well with other estimates of grizzly bear trends in the park.

Harris (1986a) noted that although secondhand reports are inexpensive compared to other methods of trend estimation, interpretation of secondhand data can be problematic. Sources of variation other than actual increases or decreases in bear populations may include observer bias, habitat alteration and fluctuating interest in filing reports. Such biases can be handled with appropriate models but quantifying these variables may be difficult.

Harvest Data as an Index of Population Size and Trend

The analysis of harvest rates and age/sex ratios to assess population size and trends has received considerable attention in the literature. Harris (1986a) identified 3 major categories of harvest data analyses;

1. those which use trends in the number of animals killed to identify population trends
2. those which treat the age and sex structure of the harvest as representative of the general popula-

tion (unbiased sample) and construct a life table using these data

3. those which recognize inherent biases in harvest age/sex data and draw inferences about the population's status by interpreting the data in light of these biases.

The first method has not been commonly used for bear population studies (Harris 1986a). Carlock et al. (1983) found a weak correlation between legal harvest of black bears in Tennessee and population size (as estimated by the Jolly-Seber method). The harvest followed the same general trend as the population but a time lag occurred between the 2. Pearson (1975) pointed out that grizzly bear harvest trends may only reflect the abundance of bears in preferred hunting areas rather than the region-wide trend. This problem may be most pronounced in areas such as the Yukon, where most grizzly hunting is done by guided outfitters who tend to hunt the same areas each year.

The second method, use of harvest age ratios as an unbiased sample, was used in several areas. Caughley (1974) noted that age ratios often provided ambiguous information on population trends. Similar age ratios can result from very different population trajectories and, without additional demographic data, age ratios alone are uninterpretable.

Pearson (1975) used age/sex data from 5 years of harvest to construct a life table and calculate mortality rates for grizzly bears from the Yukon and Northwest Territories. Age ratios have also been used as a crude index of population trend in some Alaskan hunting units to supplement information from other sources (Barnett 1984, Seward 1984).

The third method uses information on the differential vulnerabilities of specific age/sex classes to draw inferences on harvest intensity. Bunnell and Tait (1980, 1985) found that, due primarily to their larger home ranges, male bears were overrepresented in the harvest. The magnitude of the sex-specific difference varied according to the particular hunting method employed. They found that certain counterintuitive results could arise from these differential vulnerabilities. For example, although males of all age classes were more vulnerable to harvest than females, the ratio of males to females in the harvest declined in the older age classes because fewer older males were available for harvest. Thus, in heavily hunted bear populations where males were more vulnerable to harvest than females, the overall sex ratio of the kill could be close to 50:50 (Bunnell and Tait 1980).

Paloheimo and Fraser (1981) and Fraser et al. (1982) presented a statistical model to use the age-related changes in harvest sex ratio to estimate the rate of harvest and the population size. Several assumptions vital to the application of this model are not commonly met by bear harvest data. Harris (1986b) elaborated on the inherent difficulties with Fraser et al. (1982) and related methods.

Harris (1984, 1985a) used a stochastic simulation model to investigate the age/sex structures of grizzly bear populations with increasing harvest pressure. His results generally agreed with the predictions of Bunnell and Tait (1980) and Gilbert et al. (1978) regarding the effects of increased male vulnerability. However, his simulations revealed an inherent low sensitivity of harvest data to short-term population trends. Pronounced time-lags in the response of age/sex ratios to changes in harvest level confounded interpretation of harvest data. For example, 2 harvest simulations, 1 at a sustainable harvest rate and the other at an extreme overharvest, resulted in similar mean female ages for 6 years after initiation of the new harvest regimes. The author concluded that even the most sensitive harvest indices were highly variable and the ability to detect trends in small grizzly bear populations based on harvest data was weak.

The models discussed above (Bunnell and Tait 1980, 1981, 1985, Paloheimo and Fraser 1981, Fraser et al. 1982, Tait 1983, Harris 1984, 1985a) have provided some insights into the behavior of age/sex ratios as a function of various levels of harvest and population trajectories. However, it appears that more research will be required before these indices can be used with confidence to evaluate population trends.

Dood et al. (1986) considered the use of harvest age data to assess population trends or harvest intensity in Montana. Due to the ambiguous interpretations of these data, they concluded that age data could only be appropriately applied in conjunction with other trend indicators. Tompa (1984) acknowledged the limitations of harvest data for lifetable calculations, but felt that differences in age/sex kill samples over time would reflect the actual population structure providing that differential vulnerabilities of specific classes were persistent during the period. He utilized data for 3000 grizzly bears harvested in British Columbia over an 8-year period (along with mortality and natality rates from the literature) to determine regional population trends.

Surveys Using Tracks and Other Bear Sign

Counts of tracks, scats, bear trees or other sign have 2 obvious advantages over other census methods; they are inexpensive and they do not require bears to be handled or otherwise disturbed. Unfortunately, sign counts do not generally yield the precision desired for rigorous population analyses.

Bear tracks have been used as a rough index of grizzly bear abundance in a number of areas. A series of surveys conducted in northern Montana used the number of tracks or scats observed per mile travelled to supplement data from direct observations of grizzlies (Cooney 1941, Stockstad 1954, Marshall 1955). Measurements of tracks helped to minimize duplication in these counts.

Klein (1959) and Edwards and Green (1959) evaluated the use of tracks for censusing grizzly bears on Admiralty Island and in British Columbia, respectively. Data from both studies indicated that track-counts were not an effective technique for population censuses, but the reasons differed. Klein (1959) found that track measurements did permit discrimination between individual bears except where bear densities were high. He felt that the main obstacle in using track-counts was determining the proportion of bears not feeding at the salmon streams where the track-counts were made.

Edwards and Green (1959) concluded that variation in track measurements due to stride and substrate condition

precluded the use of track-counts for censuses. Valkenburg (1976) used a stepwise discriminant analysis to differentiate between 63 different sets of brown bear tracks measured in Mt. McKinley National Park, Alaska. Only 3 sets could be distinguished at the 95% probability level. Similarly, other researchers found that variability or overlap in track measurements prevented reliable separation of individuals (Pearson 1965a, Lloyd 1979). However, under some circumstances, track counts can be helpful for making rough comparisons of bear densities between areas (Klein 1959, Russell 1974).

The use of scat surveys to assess bear densities has several inherent problems. Grizzly bear defecation rates may vary by season, diet, age class and between individuals (Smith 1978, Roth 1980). Attempts to estimate bear densities from scat occurrence must account for this variation. Furthermore, lack of a reliable method for differentiating between black and grizzly bear scats is a major problem where both species occur in close proximity. Separation of grizzly and black bear scats according to diameter and volume (e.g., Husby et al. 1977, Smith 1978) may discriminate against smaller grizzlies. Methods to distinguish species using fecal bile acids are being investigated (Goodwin and Miller 1982, Welsh and Picton 1984).

Smith (1978) recorded the number of scats deposited per day on a road in his coastal British Columbia study area. He used this index to gain a rough estimate of bear use of various areas and habitats adjacent to the road. Systematic scat surveys are conducted annually in some Alaskan Game Management Units (Townsend 1985). These surveys assess seasonal and annual bear occurrence according to the number of scats per mile of road.

Sign surveys have some of the same problems as counts at concentration areas. To establish annual trends, the survey must be conducted under comparable conditions (e.g., same phase of the salmon run) each year. If counts at concentration areas are to be extrapolated to a broader area, the researcher must have some prior knowledge about relative distribution and habitat use patterns within the area. Alternatively, the sign survey can be calibrated with another more rigorous population estimate (Harris 1986a). Carlock et al. (1983) found that black bear scat occurrence along index routes correlated poorly with population trends in 2 out of 5 years.

Bait and Scent Stations

Bait stations have been used with some success to census black bears and other carnivores (Lindzey et al. 1977, LeCount 1982, see review in Harris 1984, 1986a). Application of this technique for grizzly bears has been attempted in only a few studies. Winter (1969) used horse carcasses to attract grizzlies to 15 bait stations in the Yellowstone ecosystem. The low response rate was attributed to the bait being too fresh and to the short observation period.

A later study in the Yellowstone area used time-lapse cameras placed at bait stations to document grizzly bear use (Ball 1976, 1980, Roop 1977). Thirty-six stations were monitored for 551 camera days in 1975-76. Three categories of lures were used: scents (nonconsummable), horse carcasses (consumable) and combination lures (scent and carcass). Thirty-one bears, including 5 grizzlies, were identified at 15 stations. Carrion, and scents which mimicked carrion, were the most efficient baits although none were very successful, especially when natural foraging conditions were favorable. Nonconsummable baits had the advantage of attracting bears without enticing them to remain at the station and thereby inhibiting other bears from visiting the bait. Consumable baits could contribute to the association of human activity with food reward (Jonkel pers. commun.).

Smith (1978) also used cameras to document grizzly occurrence but, unlike the above study, he did not use baits to attract bears. Cameras were placed along natural movement corridors and a line was stretched across the corridor to trigger the shutter.

Sumner and Craighead (1973) used bait stations to census grizzly bears in the Scapegoat Wilderness Area. They placed 6 horse carcasses in a variety of habitats throughout their study area and maintained continuous observation of the carcasses from the time of placement until they were consumed. Grizzly bears visited 50% of the carcasses. Time elapsed from placement to first visit varied from 3-16 days. Grizzlies visiting the stations included all previously recorded bears plus 2 additional bears which had not been recorded. The researchers felt that the use of carcasses was superior to direct observation without baits as a means to count and classify grizzlies.

Harris (1984a) tested several scent station techniques for censusing grizzly bears in Montana. A variety of attractants were used including synthetic compounds and sardines. "Hair grabbers" (wool cards) or time-lapse cameras were installed at some stations to verify bear species. In the first set of experiments, the response rate was 1.3% (2 visits in 150 operational station-nights). In a second set of experiments, in which an attempt was made to place scent stations in proximity to radio-collared grizzlies, the response rate was only 0.82% (3 visits in 367 station-nights). Based on these results, Harris (1986a) reached the following conclusions:

1. Wool cards were effective for collecting hair samples only if the visiting animal made physical contact with them, however, even when hair was collected, species discrimination from hair micromorphology (e.g., Picton and Knight 1980) was not always certain.
2. Results from time-lapse photography were inconclusive. Infra-red, motion-detecting systems could be used, when funds permitted, for photographing nocturnal activity.
3. Sardines appeared to be the most efficient bait, although all attractants preformed poorly.
4. The relationship of a bait station index to population numbers was not determined. Some calibration with another population estimator was needed to at least ascertain the nature of this relationship (i.e., linear or non-linear).
5. The primary difficulty with using scent station indices was in obtaining adequate sample sizes for analysis. Sample sizes to detect true (statistically significant) differences between 2 bait station indices could be exceedingly large when response rates were low.

6. Although bait stations may be unsuitable for detecting small changes in population abundance, they could be useful for detecting gross changes or as an indicator of presence/absence.

Surveys Without Marked Bears: Direct Counts and Aerial Censuses

Direct ground counts

Direct counts are often used to census grizzlies when marking programs or other techniques are infeasible or undesirable. Based largely on undisputed direct counts of grizzlies, Martinka (1971, 1974ac) estimated the bear density within a 290 sq mi sample area in Glacier National Park. He then derived a park-wide population estimate by extrapolation from the sample area density. Hoak and Clark (1980) and Hoak et al. (1983) used direct sightings by qualified observers as a method to determine the status and distribution of grizzly bears in the Bridger-Teton National Forest. Potential problems with direct ground counts include incomplete sampling, sampling biases and variability associated with small sample size or effects of uncontrollable variables (Harris 1986a).

Known bears

Some direct counts attempted to determine a minimum population estimate by identifying individual bears and groups of bears. Identification based on pelage or other unique characteristics can be used along with knowledge of marked or harvested bears to increase the number of "known" bears in an area (Craighead et al. 1973, 1974, Reynolds 1974, Pearson 1975, Nagy and Russell 1978, Russell et al. 1979, Miller and Ballard 1982a, Nagy et al. 1983ab, Reynolds and Hechtel 1983a, Aune et al 1984, McClellan 1984, Aune 1985, Aune and Stivers 1985). Difficulties with using known bears are similar to those with direct counts. Seasonal variation in pelage characteristics can pose a problem when recognition is based on pelage alone. Peacock (1978) and Knight et. al. (1975) attempted to overcome this problem by photographing grizzlies.

Counts at concentration areas, aerial censuses

Bear attendance at seasonal concentrations of preferred forage items has frequently been used to gauge trends in the population at large. These surveys may be conducted from the air (e.g., Glenn 1971, Kendall 1983a, 1984ab, 1985); from the ground (Peacock 1978, Singer 1978); or, in combination (Troyer 1962, Troyer and Hensel 1969, Barnes 1985).

Data from the Black Lake area of the Alaska Peninsula illustrates the usefulness of aerial survey data. Aerial surveys recorded brown bear usage of salmon streams in this area from 1962-1969. Several replicates were conducted annually. The peak number of bears observed each year were averaged to give a mean of 103 bears/survey or 38 bears/hour. Annual surveys in the Black Lake area were resumed in 1982 (several were conducted in the intervening years). Data from 10 surveys, 1982-84, showed a mean of 145 bears/survey, about 40% higher than the peak surveys during the 1960s. The researchers felt that, despite the unquantified biases associated with aerial censuses, these results suggested a large, stable, or increasing population (Sellers and McMay, in Townsend 1985).

Aerial surveys over broader areas have also been conducted. Crook (1971) used aerial survey transects along river valleys to census bears in an 84,000 sq mi study area in northern Alaska. The survey method was designed to minimize biases due to bear activity patterns, bear avoidance of aircraft, season, aircraft type and other sampling biases. However, bear densities calculated from replicate surveys over the same area were highly variable. The researcher concluded that relative abundance comparisons were not possible given the limited data.

Since 1974, a number of aerial census techniques have been used to monitor the Yellowstone grizzly bear population. Knight et al. (1977, 1978) attempted to determine the minimum number of grizzly bears by recording numbers of unduplicated individuals seen during aerial surveys. Location of the bear, obvious age, sex or coloration distinctions and photographs were used to distinguish individual bears and groups of bears. In 1983, an ad hoc committee for population analysis suggested a method to estimate population size and trends from the number of unduplicated females with cubs (the most readily identifiable segment of the population) observed over a 3-year period (Knight 1983). Subsequently, an intensive aerial survey system involving 3 aircraft working simultaneously for 4 days was developed to standardize the system for monitoring females with cubs (Knight 1984). Weather problems and observer fatigue rendered this system impractical. However, a somewhat less intensive flight system was developed which would cover only areas where females with cubs had been sighted during the previous 10 years. Other prospective indices based on grizzlies seen per hour flying and grizzlies seen per flight were also considered (Knight and Eberhardt 1985).

Klaver and Claar (1982) attempted to develop a survey technique based on counting bears as they left dens. They selected females with young as the best class for monitoring. The censuses were conducted for 2 years but only 1 family group was seen during the 2 surveys. The researchers concluded that den surveys were expensive and had limited efficiency. They recommended that if the technique was to be applied in other areas the researchers should have some prior knowledge of denning habitat in the study area and radio-collared bears should be monitored to ensure proper timing of the survey.

Difficulties and biases with aerial surveys

The inherent biases in traditional aerial surveys are well recognized. Inconsistencies in survey data can arise from differences in observer skill and experience, time of day, season, weather, lighting condition, food availability and other considerations (Ericksen and Siniff 1963, Erickson 1965, Crook 1971, Knight and Eberhardt 1985). Even with the aid of telemetry equipment, grizzly bears are difficult to observe (Knight et al. 1977, 1980, Hamilton and Archibald 1984). Troyer and Hensel (1969) found that aerial observers located less than 25% of the bears known to be present in the Karluk River drainage. Erickson and Siniff (1963) conducted 10 simultaneous air and ground surveys along coastal Alaskan salmon streams. The air observers recorded an average of only 47% of the bears known to be present from the ground surveys.

Group identification and classification is also difficult from the air. Barnes (1984, 1985) reported that ground observers were able to identify a higher number of individual grizzly bears feeding along 2 Kodiak Island salmon streams than did aerial observers. In that study, numerous

replicate surveys were conducted from both the air and ground. Ground crews were able to spend more time observing individual groups to obtain accurate age and sex classifications. Erickson (1965) found that although aerial observers did not differ significantly in their abilities to make total counts, their classification of bears did differ. Knight et al. (1975) felt that photos taken from the air could help to distinguish individual bears and groups.

As noted previously, many aerial censuses are conducted at concentration areas, such as salmon spawning streams, berry patches or garbage dumps. For these counts to yield reliable data on population composition, it must be assumed that the age and sex class composition at the concentration area is the same as the composition in the population at large (Harris 1986). Annual censuses of grizzlies on McDonald Peak appear to include a disproportionate number of adult females (Klaver in Harris 1986). Similarly, timing of an aerial survey can influence the results. At McNeil Falls, Alaska, adult brown bears fished for salmon most often in the afternoon and evening periods (Egbert and Stokes 1976). Thus, censuses conducted in the morning might underrepresent adult bears. Erickson and Siniff (1963) found large differences in the overall number of bears observed at different times of day during aerial surveys on the Alaska Peninsula.

Harris (1986a) evaluated the precision of aerial bear surveys by reviewing data in the literature for biologically unrealistic annual changes and variability between replicate surveys. Data from 3 Alaskan surveys suggested average annual increases of 42 to 158% — rates of increase deemed unrealistically high given the bears' low reproductive rate. Review of within-year replicate counts indicated coefficients of variation (standard deviation divided by the mean) ranging from 36 to 149%.

Means to Minimize or Correct for Biases in Aerial Surveys

Harris (1986a) reviewed the literature on aerial survey biases and discussed quantitative procedures for handling these biases. The following discussion pertains only to techniques which have been applied to grizzly bears.

Erickson and Siniff (1963) evaluated the factors influencing aerial surveys of brown bears in coastal Alaska. Factors which had a significant effect on census results included time-of-day, weather factors and ability of different observers to distinguish between age classes. They determined that at least 15 replicate surveys would be required to derive a 95% confidence interval equal to 10% or less of the mean population estimate.

Caughley and Goddard (1972) developed a method to estimate the number of animals in an area from the mean and variance of several counts conducted at 2 levels of survey efficiency. Reynolds (1974, 1975) attempted to employ this "differential efficiency" method to estimate grizzly bear populations in the North Slope, Alaska area. This method yielded an estimate of — 6.0 bears and the technique was rejected in favor of direct counts of marked and distinguishable bears.

One source of variability in surveys at concentration areas can be reduced by synchronizing the survey with the same phase of the aggregation each year. Kendall (1983a, 1984ab, 1985) conducted annual helicopter surveys of bears in a large huckleberry patch in the Apgar Mountains of Glacier National Park. Each year, berry development was monitored so that the survey could be timed to coincide with maximum succulence of the berry crop. Erickson and Siniff (1963) noted that because of the great differences in timing of salmon migrations and, consequently, of bear concentrations on different stream systems, prior knowledge of the bear-salmon relationships in each area was necessary before initiating aerial surveys.

Erickson (1965) reported that stratified aerial sampling techniques for censusing bears was tested on Kodiak Island. However, since most brown bears sought shelter when alarmed by aircraft, the technique was unworkable except in relatively open terrain.

Mark-Recapture Studies

Mark-recapture studies have been used to evaluate the size and trends of grizzly bear populations in several areas. Lincoln-Petersen which requires only a single recapture, is the most common mark-recapture method. Hornocker (1962) used the Petersen Index method to estimate the number of grizzly bears using the Trout Creek dump in Yellowstone National Park in 1960 and 1961. In this study, "recaptures" were actual physical recaptures rather than visual observations used in most other mark-recapture studies. Estimates from this method were lower for both years than estimates from either the Schnabel method or direct counts; small sample sizes and selective capture methods were likely problems. Craighead et al. (1973) reported that the parkwide population estimates derived from both the Petersen and Schnabel methods were comparable to their direct count estimate.

Reynolds (1974) used the Lincoln Index to estimate the grizzly bear population for a segment of his Alaskan North Slope study area. Data from 18 aerial surveys were used to calculate the ratio of marked to unmarked bears for the analysis. The estimated population size from this method was comparable (slightly higher) to the estimate from direct counts of identifiable bears along the survey route. Thirty-six percent of the grizzlies sighted during the survey were marked animals. Wood (1974, 1975, 1976) used the ratio of marked to unmarked brown bears observed at Hood Bay (Admiralty Island, Alaska) to derive a rough population estimate for his study area.

Miller and Ballard (1980, 1982a) used a modified Petersen Index to estimate the brown bear population size and density in their southcentral Alaska study area. Forty-eight bears were captured and removed in 1979 as part of a moose calf mortality study. Twelve brown bears marked in 1978 served as the basis for the Petersen Index, and separate mark-recapture calculations were performed for each sex. The "raw" estimates for females and newborn cubs were adjusted upwards to correct for the apparent low probability of capture for these groups. The researchers felt that their procedures provided a realistic and replicable method for estimating population size and density.

Miller (1985a) reported a further modification of the above procedure. A series of independent population estimates were determined from the ratio of marked (radio-collared) to unmarked bears observed during aerial censuses. Unmarked bears seen during these censuses were captured and marked so that the total mumber of marked animals in the population increased over time. To deter-

mine the number of marked bears actually present within the defined search area, a correction was made for bears whose home ranges overlapped the search area boundaries. These bears were assigned fractional "presence" values based on the proportion of times they were relocated inside the boundaries. This procedure corrected for the demonstrated absence of closure for this brown bear population. A subsequent publication reported further reinforcement for this aerial census technique (S. Miller et al. in press).

The Schnabel method has been used less frequently than the Lincoln-Petersen Index for grizzly bear mark-recapture studies. Hornocker (1962) used data from 23 and 29 counts in 1960 and 1961, respectively, to estimate the Trout Creek grizzly population using the Schnabel estimator. Results from this estimate correlated closely with direct count estimates. Troyer and Hensel (1969) used the Schnabel method to determine the size of the brown bear population on their Kodiak Island study area. The data collection procedure described by Miller (1985a) and discussed above was similar to the Schnabel method in that all unmarked animals seen during the censuses were captured and marked, however, the standard Lincoln Index was used for data analysis.

Pelton and Marcum (1977) and Carlock et al. (1983) injected captured black bears with radioactive isotopes and then used the Schnabel method for estimating population size according to the ratios of tagged to untagged droppings collected on trails. Use of the radioactive feces-tagging technique had several advantages over traditional mark-recapture methods including large sample size and minimization of animal handling. Tagging and scat collection in both studies were done on the same trail system, thus, 1 possible source of bias was disproportionate sampling of trail-habituated bears. The radioactive-tagging technique has not been applied to grizzly bear population estimates.

The Jolly-Seber method of population estimation (Jolly 1965, Seber 1965) allows for immigration, emigration, death and recruitment to the census area. This "open" model for mark recapture studies has been applied to bears less frequently than the "closed" models (Lincoln-Petersen and Schnabel methods) discussed above. Roop (1980b) described an attempt to apply the Jolly-Seber and Manley-Parr estimates to Yellowstone grizzly bear data. Trapping data used in his analysis were collected opportunistically and violated the models' requirement that trapping effort be evenly distributed in space and time. Beecham (1980) and Carlock et al. (1983) used the Jolly-Seber method to estimate the size of black bear populations in Idaho and the southeastern United States, respectively. In the latter study, the Jolly-Seber estimate appeared to be the most appropriate estimation method.

Harris (1986a) discussed problems in the use of mark-recapture studies for grizzly bear populations. Population closure is assumed by the Lincoln-Petersen and Schnabel estimators but this assumption is seldom met by grizzly bear studies. Miller and Ballard (1980, 1982a) found no evidence to indicate that the closure assumption was violated in their brown bear removal study. As discussed earlier, subsequent studies in the Susitna area adjusted for movement of marked bears into, and out of, the study area (Miller 1985a, Miller et al. in press). This was the only study in which specific corrections for lack of closure were incorporated into the analysis.

Most mark-recapture estimators also assume equal catchability of all members of the population throughout the survey period. Unequal catchability in bear population studies can arise from seasonal variation in trap vulnerability, individual variation in trap response, prior trap history, effects of trap distribution and age/sex class variation (Harris 1986a). Partitioning of the population into separate age/sex class groups for data analysis can alleviate some of the unequal catchability difficulties. Miller and Ballard (1980, 1982a) made separate calculations for each sex and only included animals older than 3 years. Estimates for the cub through 2-year-old age classes were inferred from other data. Beecham (1980) also chose to limit his estimates to adult age classes.

Small sample sizes, high variability and large confidence intervals are typical of most bear mark-recapture studies. Reynolds (1974) had a 95% confidence interval width equal to 151% of his population estimate. Miller and Ballard (1980, 1982a) had a 95% confidence interval width of 230% for their uncorrected Petersen estimate. Comparable figures from the Jolly-Seber estimates were 71% (Roop 1980) and 47% (Beecham 1980). DeMaster et al. (1980) developed a modified Jolly-Seber method for use with polar bears that improved the precision with small samples but required a stable age distribution and equal catchability. Pollock (1982) suggested an a sampling regime for the Jolly-Seber method to allow for unequal catchability.

Population Modelling

Population projection models require reliable data on litter size, breeding age, breeding interval, survivorship and age/sex structure of the modelled population (Harris 1986b). Since these parameters often vary greatly between bear populations (Bunnell and Tait 1981, 1985) and many years of data collection are usually required to obtain reliable values, sufficient data for population modelling are available for few bear populations.

A number of models have been constructed using data for the Yellowstone grizzly bear ecosystem. Based primarily on their data collected from 1959-1970, Craighead et al. (1973) developed a simulation/projection model for Yellowstone grizzlies. Both stochastic and deterministic models were discussed therein. A subsequent report (Craighead et al. 1974) reported further on the deterministic Leslie matrix type simulation model. A primary objective of their simulations was to evaluate the potential effects of the new management policies which began in 1968.

The Craighead et al. (1973, 1974) model assumed a stable age distribution and constant rates of reproduction and mortality throughout the analysis period. The lack of compensatory processes in their model was criticized by Cowan et al. (1974) and McCullough (1981). Further analysis of the Yellowstone data suggested that certain compensatory relationships were operative. Avrin (1976) developed a partially compensatory model for the Yellowstone grizzly population. He used the fixed survival rates of adults as previously reported by Craighead et al. (1974) but included a compensatory relationship between the number of adults and juvenile recruitment. McCullough (1981) reviewed the previous modelling efforts and constructed a model which

allowed for compensatory interactions between age structure, recruitment, sex ratio and adult mortality. Greer (1980) and Roop (1980b) also reported on population projection models for the Yellowstone bears.

Shaffer (1978, 1983) and Shaffer and Samson (1985) used a stochastic computer simulation model to study the relationship of population size to extinction probability for Yellowstone grizzlies. Density dependent mechanisms were built into the model to determine the average litter size and proportion of reproducing females. Suchy et al. (1985) modified Shaffer's program to include the more recent (1975-1982) Yellowstone data. Their simulations also tested the influence of environmental and demographic stochasticity on the long-term (100 year) viability of the grizzly population.

Knight and Eberhardt (1984, 1985) built a stochastic simulation model to study the dynamics of the Yellowstone grizzly population. In their model, individual females were followed through life with their survival and reproductive performance determined annually by stochastic assignment using calculated age-specific rates. The authors felt if the Yellowstone population stabilized at a new level some sort of inherent regulatory mechanism would probably be operative. However, since the nature of that mechanism was unknown, no compensatory processes were incorporated into their model.

Population modelling efforts for other grizzly bear populations have been limited. McLellan (1984) used a basic Leslie matrix model with no density dependent or compensatory mechanisms to examine population trends for the grizzly population in the North Fork of the Flathead Valley. Sidorowicz and Gilbert (1981) used a computer model to evaluate the effects of alternative management strategies and mortality patterns on the Yukon grizzly bear population. Taylor et al. (in press) recently developed an elaborate projection model (ANURSUS) for use with polar bear populations. As some peculiar aspects of reproductive biology (such as multiannual reproduction) are shared by all species in the genus *Ursus* (Bunnell and Tait 1981), the ANURSUS models may also prove valuable for grizzly bear population analyses.

Several models have been developed to investigate the effects of hunter harvest on grizzly bear population size and age structure. Bunnell and Tait (1980, 1981) discussed the general features of simulation models and described the effects of hunter harvest on hypothetical bear populations. A simple Leslie matrix type model with some density dependent features was used for their analyses. Harris (1984a) also investigated the effects of harvest intensity on grizzly bear age structure and population status. He used a stochastic, discrete-time, age structured projection model. Several different forms of density dependent mechanisms were tested. The reader is referred to each of these papers for more detailed discussions.

HABITAT MANAGEMENT

FOOD HABITS SUMMARY

A review of the food habits of grizzly bears on the North American continent shows that a wide variety of plant and animal foods are utilized on a seasonal and annual basis. Vegetal matter (e.g., stems, leaves, roots/corms/bulbs, fruit) and animal matter are universally important and, as such constitute 4 major food categories. Although bears have obviously adapted to local availability of foods, several items appear to comprise a significant portion of their diet in all areas. In areas where these specific major items are absent, alternate foods within the same food category are selected.

Equisetum spp. is the only plant genera used in all regions within the North American range of the grizzly bear (Table 17 and 18) and is selected during all seasons. *Equisetum* spp. is typically found in mesic habitats in association with other preferred vegetal foods. A variety of grasses and sedges are also important throughout the bears' North American range although the species selected differs by location. These 3 food types represent true staple items in the grizzly bear diet.

Heracleum lanatum, Trifolium spp. and *Taraxacum* spp. are major early, and mid-season items in coastal and Continental Divide mountain habitats. This food item does not occur throughout much of the northern interior and Arctic habitats. *Trifolium* spp. and *Taraxacum* spp. tend to pioneer early successional habitats and their use as vegetal foods correlates well with bear use of seral or disclimax plant communities. The number of vegetal food items used appears to be less within the far-northern range of grizzlies in comparison to more southern areas.

The roots of *Hedysarum* spp. are dug in all mountainous and Arctic habitats of Canada and Alaska (Table 17 and 18), but are not a major diet item in the contiguous 48 states. *H. sulpherescens*, for example, only appears in grizzly bear scats collected from the extreme northern portion of Montana (Mace and Jonkel in press) and has very limited distribution further south in the state (Mace 1986). Where *Hedysarum* spp. is absent or of limited availability, *Lomatium* spp., *Erythronium* spp. or *Perideridia* spp. roots are dug. Kodiak, Admiralty and Chichagof Islands in Alaska are the only location where a primary seasonal food was not dug.

The fruit of 2 shrub taxa constitute a vital mid- and late-season food item in much of the Continental interior. The fruit of *Vaccinium* and *Shepherdia* spp. are the primary sources for energy and fat deposition whereever available. *V. membranaceum, ovalifolim, myrtillus, scoparium, globulare, uliginosum*, and *vitis-idaea* are particularly important species to local bear populations. The overwintering berries of *Arctostaphylos* spp. are an important early-season diet item throughout Canada and in the Northern Ecosystem of Montana. The fruit of this genus is the single most important mid- and late-season energy source in Arctic habitats of Canada and Alaska (Table 17 and 18). *Rubus spectabilis* and *Oplopanax horridus* fruits are important to coastal bears.

The nuts of *Pinus albicaulis* are important only in the most southern portion of grizzly bear range. In the relatively xeric habitats of Yellowstone National Park and the Rocky Mountain East Front (Montana), these nuts either intensively supplement or basically replace the fruit of shrubs.

The grizzly bear maintained the ability to either kill or consume as carrion, mammals and fish. Local concentrations of large ungulates constitute an important source of protein wherever available. In many locations, animal matter may not constitute a major annual diet item but may be vital to bears on a seasonal basis. Caribou, elk, moose or livestock are particularly important. Salmon constitute a confined and extremely vital seasonal food in coastal habitats. Small trout are locally important only in Yellowstone National Park. Rodents, primarily ground squirrels and microtines, supplement the annual diet of the grizzly bear throughout much of Continental North America. However, in the Arctic habitats ground squirrels constitute a primary, staple protein source. Marine mammal carcasses constitute an important spring food in several coastal Alaskan and Canadian locations.

COVER

Grizzly bear cover requirements and use have not been fully documented in the literature. In all areas studied, the home range of the grizzly bear is composed of a mosaic of several to many relatively dissimilar habitat units (e.g., cover types, components, vegetation types). Grizzly bear seasonal use of these units has most often been described in terms of the presence of preferred foods items and few measurements have been obtained in reference to thermal or escape cover. Measurements of cover requirements are futher complicated by individual behavior, behavior hierarchies within a given population may determine habitat use patterns and use of cover (Mattson 1983, Schleyer 1983, McLellan and Mace 1985). The intraspecific propensity for adult males to kill young bears, for example, has led female bears in the northcentral Alaska Range to use habitats close to escape cover (Reynolds and Hechtel 1982). As with other wildlife species, annual differences in gross weather conditions, and environmental factors such as elevation, slope, topography, precipitation, temperature and wind dictate the type and degree of cover use (Schleyer 1983).

Cover use also varies with female reproductive status. Females with young often select rugged, isolated habitats throughout the range of the species (Pearson 1975, Russell et al. 1979, Glenn and Miller 1980, Sizemore 1980, Stelmock 1981, Darling in press).

Grizzly bear behavior in relationship to cover use may also vary between hunted and unhunted populations. The lack of secretive behavior and associated use of open habitats has been documented in wildlife preserves (Hamer 1985). Conversely, it is theorized that individuals from hunted populations use habitats with relatively high cover values (Archibald 1983).

McLellan and Mace (1985) investigated the behavior and habitat use patterns of grizzly bears in response to road traffic, seismic activity and people on foot. Analyses showed that grizzly bear use of habitats within 100 m of an open road was less than expected for the habitat available. Because substantial clearcutting had occurred adjacent to

Table 17. Summary of major food items used by grizzly bears in Canada, by geographic location.

	ECOSYSTEM[a]					
Food	Coastal	Interior Mtns.	Rockies Mtns.	Boreal Forest	Northern Interior	Arctic
Vegetal Parts:						
Equisetum spp.	NS	1,2,3	1,2,3	1,2	1,2,3	2,3
Graminae spp.	NS	1,2,3	1,2,3	1,2,3	1,2,3	2,3
Carex/ Juncus spp.	1,2	1,2,3	1,2,3	1,2,3		
Lysichitum americanum	2					
Rubus spectabilis	2					
Vaccinium spp.	1,2					
Claytonia lanceolata		2				
Oxyria digyna			2			
Heracleum lanatum	NS	2	2	NS		
Trifolium spp.		1,2	1,2,3		NS	
Athryium filix femina	1,2					
Oplopanax horridus	2					
Angelica spp.			2			
Taraxacum spp.			1,3			
Salix spp. (catkins)					1	
Osmorhiza spp.						
Ligusticum spp.						
Mitella brewerii						
Tiarella trifoliata						
Luzula hitchcockii						
Claytonia lanceolata						
Circium scariosum						
Boykinia richardsonii						
Oxytropis spp.						
Hordeum brachyantherum						
Carex macrochaeta						
Lupinus nootkatensis						
Eriophorum vaginatum						
Roots/Corms/Bulbs:						
Hedysarum spp.		NS	1,2,3			
H. alpinum			1,3		1,2,3	1
H. sulphurescens			1,3			
Claytonia lanceolata						
Osmorhiza chilensis	NS					
Angelica genuflexa	NS					
Oplopanax horridus	1					
Erythronium grandiflorum		2				
Lomatium spp.						
Polygonum spp.						
Perideridia gairdneri						
Eriophorum vaginatum						
Fruit:						
Chimpaphila umbellata		3				
Oplopanax horridus		3				
Shepherdia spp.		NS	2,3		2,3	
Empetrum nigrum					2	1
Vaccinium spp.	2	2,3	2,3	2,3	2,3	2
Ribes spp.	2	2,3				
Arctostaphylos spp.		1	1		1	2
Cornus sericea	NS					
Lonicera spp.	NS					
Rubus spectabilis	2					
Viburnum edule	NS			2,3		
Sorbus spp.		2,3				
Sambucus spp.	2					

Table 17. (Continued)

Food	ECOSYSTEM[a]					
	Coastal	Interior Mtns.	Rockies Mtns.	Boreal Forest	Northern Interior	Arctic
Crataegus spp.			2,3			
Rhamnus alnifolia			2,3			
Prunus virginiana						
Amelanchier alnifolia						
Domestic apples, plums, cherries						
Rosa acicularis						
Pinus albicaulis (nuts)						
Mammal/Avian Fish/Insect:						
Caribou						1
Salmon or trout	2,3					
Moose						
Wild ungulate carrion/predation	1	1,3		1,2,3		
Domestic livestock (Carrion/predation)						
Rodent		1,2,3			3	2,3
Bird		2				
Colonial nesting bird eggs				1,2		
Insect		1,2,3	2		2	
Earthworms						
Marine mammal carrion					1	

[a]NS = season not specified, 1 = early season, 2 = mid-season, 3 = late season (actual seasonal dates differ among study area).

Table 18. Summary of major food items used by grizzly bears in the United States by geographic location.

Food	ECOSYSTEM[a]								
	Northern Ecosystem	Selkirk Ecosystem	Yellowstone Ecosystem	Kodiak Island	Interior Alaska	Arctic Alaska	South Central	Alaska Peninsula	Southeast Alaska
Vegetal Parts:									
Equisetum spp.	1,2,3	1,2	1,2,3	2,3	1,2,3	2	1,2	1,2,3	1,2,3
Graminae spp.	1,2,3	1,2	1,2,3	1,2,3	1,2,3	1,2,3	1,2	1,2,3	1,2,3
Carex/Juncus spp.	1,2,3	1,2	1,2,3	1,2,3	1,2,3	1,2,3	1,2	1,2,3	1,2,3
Lysichitum americanum								1,3	
Rubus spectabilis									
Vaccinium spp.									
Claytonia lanceolata									
Oxyria digyna									
Heracleum lanatum	1,2,3			2,3					
Trifolium spp.	1,2,3	1,2	1,2,3						
Athryium filix femina									
Oplopanax horridus									
Angelica spp.	2,3			1,2					
Taraxacum spp.	1,2,3		1,2,3						
Salix spp. (catkins)									
Osmorhiza spp.	2	NS							
Ligusticum spp.	1,2	2							
Mitella brewerii		3							
Tiarella trifoliata		3							
Luzula hitchcockii		NS							
Claytonia lanceolata			1,2						
Circium scariosum			2,3						
Boykinia richardsonii					2,3	2			
Oxytropis spp.					1,2	2			
Hordeum brachyantherum				1,2					
Carex macrochaeta				2,3					
Lupinus nootkatensis				2,3					
Eriophorum vaginatum						1			

Table 18. (Continued)

Food	ECOSYSTEM[a]								
	Northern Ecosystem	Selkirk Ecosystem	Yellowstone Ecosystem	Kodiak Island	Interior Alaska	Arctic Alaska	South Central	Alaska Peninsula	Southeast Alaska
Roots/Corms/Bulbs:									
Hedysarum spp.									
H. alpinum					1,2,3	1,2,3			
H. sulphurescens									
Claytonia lanceolata	1,2	1							
Osmorhiza chilensis									
Angelica genuflexa									
Oplopanax horridus									
Erythronium grandiflorum	1,2	1							
Lomatium spp.	1,3	1	1,2,3						
Polygonum spp.			1,2,3						
Perideridia gairdneri			2,3						
Eriophorum vaginatum						3			
Fruit:									
Chimpaphila umbellata									
Oplopanax horridus				2,3			2,3	2,3	2,3
Shepherdia spp.	2,3				2,3				
Empetrum nigrum				2,3	1,2,3		2,3	2,3	
Vaccinium spp.	2,3	2			2,3		2,3	2,3	
Ribes spp.									3
Arctostaphylos	1					1,3			
Cornus sericea									
Lonicera spp.		2							
Rubus spectabilis				2,3			2,3	2,3	
Viburnum edule				2,3	3		2,3	2,3	
Sorbus spp.	3								
Sambucus spp.				2,3					
Crataegus spp.	2,3								
Rhamnus alnifolia	2,3								
Prunus virginiana	2,3								
Amelanchier alnifolia	2,3								
Domestic apples, plums, cherries	2,3								
Rosa acicularis					3				
Pinus albicaulis (nuts)	3		1,3						
Mammal/Avian/Fish/Insect:									
Caribou					1,2,3	1,2		1	
Salmon or trout			2	2,3	3		2,3	2,3	2
Moose							1,2	NS	
Wild ungulate (carrion/predation)			1,2,3	2,3	1,2,3		1	1	1
Domestic livestock (carrion/predation)	1,2,3			1,3					
Rodent	2,3	NS	1,2,3		1,2,3				
Bird Colonial nesting bird eggs				1					
Insect	1,2,3	2	1,2,3						
Earthworms		3							
Marine mammal carrion				1				1	

[a]NS = season not specified, 1 = early season, 2 = mid-season, 3 = late season (seasonal dates differ among study area).

many of these open roads, McLellan and Mace (1985) hypothesized that the loss of cover was more responsible than the intensity of traffic. Visual cover was important in predicting a bear's response to human stimuli. Bears in direct view of vehicles usually fled to adjacent cover, whereas bears close to roads but in cover did not appear to be affected. Limited data also suggested that the need for vegetative or topographic cover was less during night hours. The importance of security cover was indicated during seismic activity. No indication of displacement was observed by McLellan and Mace (1985) when bears were in cover, but displacement appeared to occur when several bears were in relatively high-elevation, open habitats. Helicopter traffic at 1500 m distance appeared to have little effect on bears, even when in open habitats with little cover.

Schleyer (1983) analyzed the daily activity patterns of instrumented grizzly bears in Yellowstone National Park, and found that some individuals were primarily nocturnal and others more diurnal. In general, nocturnal bears foraged in open and ecotonal areas but were quick to seek timbered cover before or soon after light. Bedding areas were often located in dense timber with downfall. Schleyer (1983) also observed that ungulate carcasses located in open areas were usually dragged to cover before being consumed. Thermal regulation and the need for seclusion are probable causes for bears to seek cover during daylight hours of summer (Jonkel 1980a).

Blanchard (1983) documented that instrumented grizzly bears in Yellowstone Naitonal Park were located in timbered habitats 90% of the time; 79% of these bears were

located in cover over 3 m tall. Of the locations in the open, most were less than 100 m from forested cover. Ground examinations showed that areas with little cover and forested areas were both used for foraging. Blanchard (1983) did not know if forested areas were used more because of foraging/bedding preference or to avoid human contact. Graham (1978) analyzed grizzly bear observation sites (e.g., tracks, scats, digs) in the Pelican and Hayden valleys of Yellowstone National Park. Graham found that the forest/open edge effect was an important factor governing bear distribution. Seventy-five percent of all observation sites were within 50 m of timber (average = 12 m). Bears that used openings greater than 100 m from timber were most often traveling (Graham 1978).

Smith (1978) measured the cover characteristics of logged areas of different ages in coastal British Columbia, and found that even recently logged areas afforded adequate visual cover. Documented use of logged areas with little vegetative cover has been minimal in the Northern Continental Divide Ecosystem. Zager (1980a) suggested that cutting unit design, size and shape affect habitat use patterns. Eighty-two percent of 34 grizzly relocations in cutting units were within 50 m of escape cover.

DENNING

Numerous studies have delineated the characteristics of grizzly bear dens and corresponding environmental parameters. The results of these investigations in the United States and Canada have been summarized and are presented in Table 19.

Variability

Within each ecosystem, den characteristics were relatively consistent with the exception of entry and emergence dates. These differences in denning chronology have been attributed to sex and age factors. In general, adult males remain active longer and emerge from dens earlier, while females with newborn cubs are usually the last to leave denning areas in the spring (Pearson 1975, Craighead and Mitchell 1982, Judd et al. in press).

For the most part, interecosystem variability can be explained by local biogeographic characteristics, learned behavior of individual bears and human environmental impacts (Hamer et al. 1977 and Craighead and Mitchell 1982).

Site Fidelity

Throughout the grizzly bear's range, researchers have observed that dens rarely occur singly, but are concentrated in areas which apparently possess appropriate environmental conditions (Craighead and Craighead 1972a, Hamer et al. 1977). These denning areas are thought to be the result of 2 factors: individual fidelity over several years and population distribution in any particular year. Regarding fidelity, Reynolds (1978) observed 8 of 13 bears denning within 5 km of their previous year's site and Valkenburg (1986) found 10 of 23 individuals within .5 km. In Banff National Park, Canada, 1 female denned within a 4.3 km diameter circle for 4 years (Hamer and Herrero 1983a).

As for the effect of distribution, Valkenburg (1986) determined that as many as 57% of the active dens near Mt. McKinley were clumped in the same area, and at Terror Lake, Alaska. Smith and Van Daele (1984) observed bears denning at a density of 2 bears/sq km.

In light of these preferences for particular areas, biologists have investigated the frequency of den reuse. Although several instances of den reuse have been documented (Craighead and Craighead 1969, Harding 1976, Servheen 1981, Miller 1984, Schoen and Beir 1985, Aune et al. 1986, Judd et al. in press), it is uncommon even when dens have remained structurally sound (Hamer et al. 1977, Servheen and Lee 1979b, Servheen 1981, Schoen and Beir 1986).

APPROACHES TO HABITAT CLASSIFICATION AND MAPPING

Several approaches have been used for the classification, evaluation and mapping of grizzly bear habitat depending on the specific research or management objectives. Theoretically, habitat classification serves to provide a stratification of a large or diverse area into smaller meaningful, yet repeatable, classes that are of value to grizzly bears and manageable by the researcher.

Classification methods used to describe grizzly bear habitat generally fall into 1 of 2 types: formal classifications that are built from precise field and analysis methods, and informal classifications that tend to subjectively stratify habitat units on the basis of apparent dominant vegetation, vegetation structure or suspected patterns of bear use. Informal techniques are less precise than formal methods, but often fulfill the classification objectives.

Habitat classifications for grizzly bear management may also be hierarchical or nonhierarchical. Hierarchical systems evaluate and then arrange or rank habitat classes in a logical or meaningful order, such as food quality. No order is assumed in nonhierarchical classifications and each unit is assumed to be of equal value to the bear.

Formal Classifications

Several researchers have attempted to formally classify grizzly bear habitat using climax vegetation classes. Banner et al. (1986) refined an existing broad climax-based biogeoclimatic system into forest ecosystem associations and seral variations. This classification for coastal British Columbia was then used to describe grizzly bear habitat use patterns for the area (Hamilton and Archibald 1986). Habitat use investigations based on the climax vegetation system of Pfister et al. (1977) have been employed in the United States (Kasworm 1985, Aune et al. 1986). Habitat inventories and evaluations incorporating, in part, the "habitat types" of Pfister et al. (1977) have been conducted by Craighead et al. (1982). Zager et al. (1983), Tiermenstein (1983) and Mace (1986).

Formal habitat classification that describe climax, disclimax, topo-edaphic climax and seral classes have been developed for numerous areas. Atwell et al. (1980) used an

Table 19. Characteristics of grizzly bear dens and corresponding environment.

Ecosystem, Area and Citation	Den Entry week[1]	%[2]	Den Emergence week[1]	%[2]	Aspect code	%	Average Slope (degrees)	Average Elevation (m)	Slope Position third[3]	%	Habitat type	%	Den Type code[4]	%	Average Chamber length (m)	width (m)	height (m)
Yellowstone National Park																	
Craighead & Craighead (1969)	11/05-11/11	57.1			N	75		2456			lodgepole pine	52.9	D	100	1.4	1.3	.9
Craighead & Craighead (1972)	11/19-11/25	42.9			NW	12.5					spruce/fir	35.3					
Craighead & Craighead (1973) [n=20]					SW	12.5					whitebark pine	5.9					
											Douglas fir	5.9					
Knight et al. (1978)	10/29-11/04	25.0	04/02-04/08	18.2	NE	40.0	37.8	2470	m	60.0	subalpine fir/whitebark pine	70.0	D	85.7	1.5	1.7	.9
Judd et al. (in press) [n=35]	11/05-11/11	41.7	04/09-04/15	54.6	SE	20.0			b	30.0	subalpine fir/shrub	20.0	C	14.3			
	11/19-11/25	16.7			SW	20.0			t	10.0	Englemann spruce/forbes	10.0					
Rocky Mountain Front																	
Aune et al. (1986) [n=60]	10/29-11/04	18.4			NE	46.0	57.2	2174			subalpine fir/whitebark pine	61.7	D	92.9			
	11/05-11/11	42.1			SE	22.0					scree	15.0	C	7.1			
	11/12-11/18	13.6			NW	20.0					subalpine fir/shrub	13.3					
	11/19-11/25	18.4			SW	12.0					subalpine fir/forbe	5.0					
											unknown	5.0					
Schallenberger & Jonkel					NE	57.1	52.0	2155	t	42.9	subalpine fir/whitebark pine	57.1					
					NW	28.6			m	28.6	subalpine fir/shrub	42.9					
					SW	14.2			b	28.6							
Glacier National Park, MT																	
Schaffer (1971) [n=2]					N	100	18.3				subalpine fir	100			4.0	1.1	.6
Mission Mountains, MT																	
Servheen (1981) [n=15]	11/05-11/11	10.0	03/12-03/18	16.7	SW	53.3	30.5	2124							2.0	1.3	1.0
	11/12-11/18	20.0	03/26-04/01	16.7	NE	40.0											
	11/19-11/25	70.0	04/02-04/08	16.7	NW	6.7											
			04/09-04/15	16.7													
			04/23-04/29	33.3													
Selkirk Mountains, ID																	
Almack (1985) [n=2]	11/05-11/11	100	04/16-04/22	50.0	NE	100	94.5	1896	+	100	timbered/mixed shrubfield	50.0	C	100	2.4	1.1	.8
			05/07-05/13	50.0							cutover shrub/rock	50.0					
Southern Rocky Mountains, CAN																	
Wielgus (1986) [n=24]					NE	33.3	25.8	2057			alpine	50.0					
					NW	25.0					spruce	29.2					
					SW	25.0					pine	12.5					
					SE	16.7					early successional	8.3					
Banff National Park, Alberta																	
Hamer and Herrero (1979)					NE	40.0	34.0	2204	m	50.0	spruce/fir/larch	40.0	D	80.0	2.0	1.7	.8
Hamer and Herrero (1980)					NW	20.0			t	25.0	meadow	40.0	C	20.0			
Hamer and Herrero (1983) [n=5]					SE	20.0			b	25.0	avalanche/shrub	20.0					
					SW	20.0											

Table 19. (Continued)

Ecosystem, Area and Citation	Den Entry week[1]	%[2]	Den Emergence week[1]	%[2]	Aspect code	%	Average Slope (degrees)	Average Elevation (m)	Slope Position third[3]	%	Habitat type	%	Den Type code[4]	%	Average Chamber length (m)	width (m)	height (m)
Jasper National Park, Alberta																	
Russel et al. (1979)	10/29-11/04	33.3	04/16-04/22	60.0	SE	60.0	27.0	2226					D	90.0	2.4	1.9	.9
[n=10]	11/12-11/18	66.7	04/23-04/29	20.0	NW	20.0							C	10.0			
			04/30-05/06	20.0	NE	10.0											
					SW	10.0											
Kimsquit River, BC																	
Hamilton (1982)					NE	33.4	80.0	785			coastal riparian	50.0					
Hamilton & Archibald (1984)					SE	33.3					mountain hemlock	41.7					
[n=12]					SW	33.3					talus	8.3					
Akamina-Kishinena, BC																	
McLellan (1981)					NE	100		1951	+	100	subalpine fir/shrub	100	D	75.0			
[n=4]													C	25.0			
Mackenzie Mountains, Northwest Territories																	
Miller et al. (1982)					SE	77.3		1623							1.7	1.3	.9
[n=12]					SW	22.7											
Mackenzie River Delta Area, NWT																	
Slaney & Company, Ltd. (1974)					S	46.7	75.0		b	50.0	tall willow	43.8					
[n=16]					N	26.7			m	37.5	dwarf shrub/heath	31.2					
					E	13.3			t	12.5	tall alder	25.0					
					W	13.3											
Nagy et al. (1983b)			04/30-05/06	13.8	SW	39.1	27.9								1.5	1.4	.8
[n=60]			05/07-05/13	36.9	SE	33.3											
			05/14-05/20	23.1	NW	21.7											
			05/21-05/27	16.9	NE	5.8											
Harding (1976)							40.0				riparian zone	79.0			1.4	1.3	.8
[n=23]											lake perimeters	13.0					
											hillsides	8.0					
Southwestern, Yukon																	
Pearson (1975)					E	40.0	35.0	1250			subalpine	100			1.8	1.4	1.0
[n=10]					S	30.0											
					W	30.0											
Arctic Mountains, Yukon																	
Nagy et al. (1983a)			04/30-05/06	87.5	SE	58.3	28.5										
[n=24]			05/07-05/13	12.5	SW	29.2											
					NE	8.3											
					NW	4.2											
Alaskan Peninsula, AK																	
Lentfer et al. (1967)					SE	27.8	33.8	300			alders	57.2			2.2	1.6	1.4
Lentfer et al. (1968)					SW	27.8					grass/moss	28.6					
Lentfer et al. (1969)					NE	27.8					willows	9.5					
[n=21]					NW	16.6					talus	4.8					
Troyer and Faro (1975)					SW	33.6	25.0	396			alder/willow	53.4					
[n=232]					SE	32.1					grasses	27.6					
					NE	22.2					alpine	19.0					
					NW	12.1											

Table 19. (Continued)

Ecosystem, Area and Citation	Den Entry week[1]	%[2]	Den Emergence week[1]	%[2]	Aspect code	%	Average Slope (degrees)	Average Elevation (m)	Slope Position third[3]	%	Habitat type	%	Den Type code[4]	%	Average Chamber length (m)	Average Chamber width (m)	Average Chamber height (m)
Smith and Van Daele (1984)	10/22-10/28	14.1	04/02-04/08	11.8				663									
Smith et al. (1984)	10/29-11/04	14.1	04/09-04/15	20.6													
[n=69]	11/05-11/11	25.4	04/16-04/22	11.8													
	11/19-11/25	12.7	04/30-05/06	11.8													
	12/03-12/09	15.5	05/21-05/27	14.7													
Mount McKinley Area, AK																	
Valkenburg (1976)					SE	50.0	25.0	850			dwarf birch	75.0					
[n=4]					SW	50.0					spruce	25.0					
Miller (1984)	10/01-10/07	14.5	04/09-04/15	11.3	SW	35.8	30.9				tundra	48.3	D	79.1	1.4	1.4	.9
Miller (1985)	10/08-10/14	23.7	04/16-04/22	11.3	SE	28.4					alder	16.7	C	20.9			
[n=70]	10/15-10/21	46.1	04/23-04/29	24.2	NE	17.9		3851			willows	15.0					
			04/30-05/06	27.4	NW	17.9					grass	13.3					
			05/14-05/20	16.1							tussock	6.7					
Alexander Archipelago																	
Schoen and Beir (1983)	10/08-10/14	11.8	04/09-04/15	10.2	NE	31.4	34.0	696			old growth forest	32.8	C	85.7			
Schoen and Beir (1985)	10/29-11/04	41.2	04/23-04/29	28.6	SW	27.4					rock	32.8	D	14.3			
Schoen and Beir (1986)	11/05-11/11	11.8	05/14-05/20	16.3	SE	21.6					subalpine	13.8					
Schoen et al. (in press)	11/19-12/02	12.9	05/07-05/13	14.3	NW	19.6					alpine	10.3					
[n=58]			05/21-05/27	14.3							avalanche	10.3					
Brooks Range, AK																	
Reynolds (1978)	10/01-10/07	36.4			SW	29.5		659			Butte/ridge	59.1					
[n=44]	10/08-10/14	36.4			NW	27.3					riparian banks	15.9					
	10/15-10/21	18.2			SE	25.0					mountain slopes	15.9					
					NW	18.2					tundra	9.1					
Curatolo and Moore (1975)	09/24-09/30	12.5			S	62.5		1021			mountain slope	87.5					
	10/01-10/07	37.5			SW	25.0					river valley	12.5					
	10/08-10/14	37.7			SE	12.5											
	10/22-10/28	12.5															
North Slope, AK																	
Garner et al. (1984)			04/23-04/29	35.7	SE	65.5	53.7	816	M	50.0	mountain slopes	89.7	D	92.9			
[n=29]			04/30-05/06	28.6	SW	13.8			B	50.0	tundra	10.3	C	7.1			
			05/14-05/20	14.3	NE	13.8											
					NW	6.9											
Quimby (1974)					SE	53.0		1063					D	69.4			
Quimby and Snarski (1974)					SW	37.2							C	30.6			
[n=49]					NW	5.9											
					NE	3.9											

[1]Only weeks with ≥10% are reported
[2]t = top, m = mid, b = bottom
[3]d = dig, c = natural cavity
[4]approximation

existing alpine vegetation classification for Kodiak Island. Alpine was grouped into communities based on species composition, structure and micro-habitat, and as such included seral to climax classes. Hamer and Herrero (1983b) provided information on bear use and habitat quality based on a precise classification of vegetation types, vegetation groups and special features. Mace (1986) developed a hierarchical classification of vegetation types present within habitat components for the Bob Marshall Wilderness, Montana. Vegetation types were based on the existing composition of the vegetation and were recorded as variable stages within the successional continuum.

Craighead et al. (1982) described "Ecological Land Units" for the Scapegoat Wilderness Area, Montana. The distinctive plant communities of repetitive land features and patterns in 3 elevation zones served as the framework for this hierarchical classification. A similar vegetation system was used by Scaggs (1979) and Butterfield and Almack (1985) in the Selway-Bitterroot Wilderness. Craighead et al. (1982) also established the foundation for remote sensing grizzly habitat using LANDSAT-1 multispectral imagery and computer analysis.

Knight et al. (1984b) used pre-established cover type maps in conjunction with vegetation data from random bear-use sites in the Yellowstone National Park area. These methods provided habitat use information for seral to climax classes. Knight et al. (1984b) also developed a prediction model of habitat quality using regression analysis. Important variables in this model were positively selected cover types, radio-telemetry densities per cover type and an index of mortality potential.

A 5-level classification system (Viereck 1982) was used by Stelmock (1981) and Darling (in press) to assess habitat use in Denali National Park, Alaska. Level 1 in this system is a general ordering (e.g., forest) and level 5 specifically denotes the dominant overstory and understory species.

Wielgus (1986) used Forest Service forest inventory maps to assess habitat use in the southern Rocky Mountains of Canada. Variables chosen for this discriminant analysis included forest cover type, percent canopy closure, stand age, mean stand height, elevation, aspect and slope. This classification system provided habitat use results that would be directly applicable to timber management.

Informal Classification

Informal habitat classification systems, less precise than previously discussed formal methods have been commonly used. Mundy (1963), for example, stratified bear observations from Glacier National Park, British Columbia into 1 of 3 units: forest, alpine or avalanche chutes. Curatolo and Moore (1975) classified observations as occurring in either river valleys or mountains. To assess the importance of timbered areas to grizzly bears, McLellan (1986) simply classified telemetry data by occurrence in either forested or nonforested areas. These 3 examples show that informal habitat classifications are adequate for certain management or research objectives.

Mealey et al. (1977) first presented the concept of delineating grizzly bear habitat components for northwestern Montana. Mace (1984) defined a habitat component as "a combination of vegetation types of a distinctive successional stage exhibiting a unique physiognomy." Habitat research by the Border Grizzly Project was tailored to the identification and evaluation of habitat components that would enhance land management decisions. The U.S. Forest Service has endorsed this component method for use in general management decisions and for cumulative effects analyses. However, because the system is informal, the implementation and mapping of components has caused much confusion when attempting to extrapolate or expand component definitions to areas with no valid habitat use information. Most components mapped to date have consisted of various types of forest openings such as meadows or shrubfields. Attempts to classify forested habitats have been hampered by the inability to photographically intrepret the understory composition of forested areas (Leach 1986).

GRIZZLY BEAR ECOSYSTEMS

Yellowstone Ecosystem

The Greater Yellowstone Ecosystem (GYE) includes Yellowstone National Park and the surrounding areas used by grizzly bears. The GYE is a large, high elevation basin surrounded by mountain ranges where elevation varies from 1620 m to 4197 m (Knight et al. 1984b). The area is widely underlain by sedimentary strata and has a history of volcanic, glacial and geothermal activity. The mountainous terrain results in relatively xeric conditions occurring in several rain shadows.

Most of the GYE is in the subalpine zone (Knight et al. 1984b, Mattson et al. in press ab). A closed canopy forest constitutes approximately 75% of the area, with *Pinus contorta* the most prominent conifer. *Picea engelmannii* is the indicated major climax species in the subalpine zone with *Pseudotsuga menziesii* at lower elevations. Higher elevation forested areas are typified by *Pinus albicaulis* and *Abies lasiocarpa*. Large contiguous nonforested areas occur below 2125 m (Mattson et al. in press) characterized by *Festuca idahoensis, Artemisia tridentata* and *Agropyron spicatum*. Nonforested rock and tundra dominate the higher elevations with *Deschampsia cespitosa* and *Carex* spp. composing significant portions of the cover (Knight et al. 1984b).

Natural fire has greatly influenced the vegetation dynamics in the GYE and forest characteristics typical of fire surpression activities are in evidence today. Large populations of elk (*Cervus elaphus*), bison (*Bison bison*), mule deer (*Odocoileus hemionus*) and moose (*Alces alces*) occur within Yellowstone National Park.

Knight et al. (1984b) have published an intensive analysis of grizzly bear diet and habitat availability/use in the GYE. Digitized cover type maps, relocations of instrumented bears and analysis of feeding sites were integrated to assess grizzly bear-habitat relationships. The GYE data base was too large to analyze as a whole, thus the data were stratified into 10 smaller analysis areas. Knight et al. (1984b also presented information on grizzly bear diet, diet diversity, feeding behavior and plant succession as related to bear use of cover types, cover type diversity and habitat use. These aspects of grizzly bear ecology in the GYE are summarized below.

General Trends in Cover Type Use

Twenty-three existing cover types were identified for the GYE, representing successional stages of apparent climax communities, nonforested types and krumholtz. The 23 cover types were distributed naturally among the 10 analysis areas. Grizzly bear use of cover types was not random. In all but 1 analysis area, cover type differed significantly from expected random occurrence, and substantial differences among analysis areas was evident (Table 20).

Bears generally preferred nonforested (NF) areas primarily during the summer. Low elevation Douglas-fir (*P. menziesii*) and *P. menziesii*/NF sites were markedly perferred in spring. Higher elevation whitebark pine (*P. albicaulis*) and *P. albicoulis*/NF sites were preferred during fall and to a lesser extent during summer. Grizzly bear use of the lodgepole pine (*P. contorta*) types was ambiguous, with climax *P. wntorta* generally avoided except in 1 analysis area. Use of the spruce (*Picea* spp.)/Douglas fir type was typically neutral or perferred in some areas.

Use of Successional Stages

Grizzly bear use of successional stages varied by analysis area depending on the availability of the stage. Differences in use were most pronounced in low-elevation *P. menziesii* and high elevation *P. albicaulis* sucessional stages where preference towards late successional, or climax types, was apparent. Ambivalence for early successional WP cover types occurred because pine nuts (a major food) are not produced until the tree is at least 100 years old. Bear use of older *P. menziesii* types was tied to the distribution of elk, another food item of the grizzly bear. In the absence of *P. menziesii* types, over-mature *P. contorta* was used during spring. Late successional or climax lodgepole types were often associated with wet to moist conditions and contained succulent plants perferred by grizzly bears in the GYE. Therefore, late successional or climax cover types were more critical than early successional stages (Knight et al. 1984b).

Diversity and Edge Density

Grizzly bears in the GYE did not select cover type diversity during any season or in any analysis area. Bears did not maximize their use of diverse cover types during spring or fall. Lingering snow-pack in the spring and very directed foraging behavior in the fall were factors responsible for this lack of selection of cover-type diversity. During summer, diversity of types used by bears approximated random expectation. Bears generally favored areas with relatively high edge density, most notably forest-nonforest ecotones. Similar conclusions were reached in other GYE studies (Graham 1978, Blanchard 1983, Brannon 1984).

Seasonal Habitat use and Food Habits

Spring

Grizzly bear habitat use patterns during spring, although variable by geographic area, correlated with availability of ungulates, characteristics of ungulate

Table 20. Seasonal use and availability of 23 cover types in the Yellowstone ecosystem from 9 analysis areas (from Knight et al. 1984) expressed as percent used.

	Seasonal Use[b]								
	Spring			Summer			Fall		
Cover Type	+	-	0	+	-	0	+	-	0
Nonforested (NF)	44		56	44		56	22	11	67
Aspen (ASP)	11		89	11	11	78	11	22	67
Douglas Fir pole stand (DF1)			100		11	89		11	89
Late successional Doug. Fir/NF	33		67	11	11	78		22	78
Late successional Doug. Fir (DF)	44		56	22	11	67		11	89
Lodgepole pine (seed-sapling) (LP)		11	89		11	89		22	78
Lodgepole pine (pole stage) (LP1)	11	33	56	11	44	44[a]		22	78
LP1/NF		11	89			100		11	89
Mature lodgepole pine (LP2)	11	11	78	11	22	56[a]	11	56	33
LP2/NF			100	11		89			100
Late successional lodgepole pine (LP)	22	33	44[a]	11	44	44[a]	11	33	56
Old lodgepole passing to spruce (LP3)	33	33	33[a]	11	56	33	11	44	44[a]
LP3/NF			100		22	78		11	89[a]
LP1/LP	11		89	22		78	11		89[a]
LP1/LP2			100	11		89			100
LP2/LP	11		89	11	11	78	11		89[a]
LP2/LP3		11	89		11	89		11	89[a]
Climax spruce and subalpine fir (SF)		11	89		22	78	11		89[a]
SF/NF		11	89		22	78	11		89[a]
Early successional whitebark pine (WB1)		11	89	11	11	78	11		89[a]
Whitebark pine (WB)		44	56	44	22	33[a]	67		33
WB/NF	22	22	56	33	11	56	67		33
Krumholtz (KH)			100			100	11		89

[a]Data insufficient for 1 analysis area.

[b]+ = use significantly greater than available, - = use less than available, 0 = not used.

winter/spring range and overall distribution and availability of cover types (Knight et al. 1984b). Areas in which ungulate concentrations occurred appeared to support most of Yellowstone National Park's grizzly population. Bears preferred forest cover on, or adjacent to, relatively open winter range sites, usually *P. menziesii, Populus tremuloides* or climax *P. contorta* stands. The tendency of grizzly bears to move carcasses to cover (Schleyer 1983) may be a factor in this observed pattern. Several large valleys and geothermally active areas attracted large numbers of elk and bison which greatly influenced habitat use and food habits of a segment of the bear population. In some areas of the Park, elk bands were smaller and occupied smaller pockets of habitat. Use of elk in these areas was less, relative to large concentration areas, and bears subsidized their diet with other items, principally *Trifolium* spp., *Equisetum* spp., and rodents. In all locations, however, interspersion, proximity of cover and ungulate restriction to specific sites characterized particularly suitable spring habitat.

Eleven diet items were of particular value to grizzly bears in the spring (Knight et al. 1984b, Mattson et al. 1986). Ungulates, rodents, and ants were animal diet items. The nuts of *P. albicaulis* were selected by some individuals. Grasses and *Trifolium* spp. foraging occurred in the nonforested and the *P. contorta* cover types. Aspen and climax *Picea* spp.-*A. lasiocarpa* types were important feeding sites for *Equisetum*.

Summer

Geographical differences in grizzly bear habitat selection in the GYE during summer were explained primarily by the distribution of either specific vegetal items or spawning cutthroat trout (*Salmo clarki*). Trout spawning in tributaries to the south and west of Yellowstone Lake appeared to draw bears from surrounding locales. The consumption of trout provided bears with a high-protein summer diet relative to other places in the GYE. Streams fished by grizzly bears were also close to nonforested cover types and provided other vegetal foods (Knight et al. 1984b).

Nonforested areas and successional *P. contorta* stages were important to bears in the plateau area of the GYE during summer. The foliage of *Taraxacum* spp., *Circium scariosum, Trifolium* spp. and the roots of *Perideridia gairdneri* and *Lomatium* spp. were major diet items. Opportunity for summer use of ungulate meat was also high in several locales and grizzly selection of cover types reflected ungulate summer range. Preferential use of *P. albicaulis* cover types during summer was also evident for those bears securing pine nuts or digging *Lomatium* spp. The fruits of *Vaccinium scoparium* and *V. globulare* were consumed primarily in the *Picea* spp.-*A. lasiocarpa* types. High elevation rock or tundra areas were not favored by bears in the GYE during summer months.

Fall

Fall cover type use in most of the GYE was explained by directed foraging on *P. albicaulis* nuts. These nuts were available generally from late August through October and were obtained from red squirrel caches within the *P. albicaulis* cover types (Kendall 1981, Knight et al. 1984b). Where pine nuts were not available such as in the Gallatin Range, continued use of ungulates in lower elevation *P. contorta* and *Populus tremuloides* types was noted.

Northern Continental Divide Ecosystem

Telemetry studies have been conducted in 4 major areas within the Northern Continental Divide Ecosystem (NCDE). Statistical analyses of habitat availability and use have been reported for the South Fork (Zager et al. 1983), the Mission Mountains (Servheen 1981), and the Rocky Mountain East Front (Aune et al. 1986.) Vegetative habitat descriptions and measurements of habitat quality were assessed in the Scapegoat Wilderness (Craighead et al. 1982), the Bob Marshall Wilderness (Mace 1986, Mace and Bissell 1986), and the Rattlesnake Wilderness (Tirmenstein 1983). LANDSAT investigations in Glacier National Park were discussed by Martinka and Kendall (1986). Mealey et al. (1977) conducted a habitat survey at selected sites throughout the NCDE. Hadden et al. (1986) described a habitat classification method developed in the North Fork.

The North Fork and South Fork of the Flathead River and the Mission Mountains are situated west of the Continental Divide in western Montana. The East Front area straddles the Divide and includes the transition zone between the Rocky Mountain Cordillera and the Great Plains. Descriptions of these areas were given by Jonkel and Cowan (1971), Schallenberger (1977), Servheen (1981), and Mace and Jonkel (in press). Pfister et al. (1977) described the forested habitat types of western Montana. The rugged mountain terrain and complex climate of western Montana create an array of habitats and associated vegetation.

The North Fork, South Fork and Mission Mountains are distinctly influenced by maritime air masses moving east from the Pacific Ocean. Upon reaching the Continental Divide, much of the moisture in these air masses has been depleted. Continental climate, dramatic temperature fluctuations and severe chinook winds influence vegetation in the East Front (Daubenmire 1969). Here, where the Great Plains meet the Rocky Mountains, extensive stands of limber pine (*Pinus flexilis*) are interspersed with aspen groves (*Populus tremuloides*) and grasslands.

Human land use patterns affect the available grizzly bear habitat in the 4 study areas. In the North and South Fork areas, timber harvesting has created a diversity of stand ages. The bench lands adjacent to the North Fork contain seasonal and permanent homes, while much of the lower South Fork has been flooded for hydroelectric power (Hungry Horse Reservoir). Livestock ranching is the major land use practice along the East Front. Livestock are grazed less commonly in the Mission Valley, but other agricultural uses of this fertile valley have altered the natural vegetation and patterns of grizzly bear habitat use (Servheen 1981).

South Fork Flathead River

Zager et al. (1983) stratified the South Fork study area into 12 habitat components (Table 21). Although all components were used annually, several components were preferred while others were avoided. During the spring (den emergence to 31 July), snowchutes and ridgetops were significantly preferred by 4 monitored bears and timber and cutting units were avoided (Zager et al. 1983). The creekbottom component was preferred but not significantly. Mace and Jonkel (1980) suggested that ridgetop components were used primarily as travel corridors. During spring, the

leaves and stems of Umbelliferae were eaten most frequently and in the greatest quantity, of which *Heracleum lanatum* and *Osmorhiza* spp. were most important. Monocots and *Equisetum* spp. were the second and third ranking foods at this time (Mace and Jonkel 1980). Snowchutes were by far the best producers of major forb food plants (Zager 1980). Mace and Jonkel (1980) reported that several bears dug the underground parts of *Erythronium grandiflorum* and *Lomatium* spp. in the snowchute and slabrock components at this time. Although not identified in South Fork scat samples, the cambium layer of several conifer species was also consumed in the spring (Bumgarner et al. 1980).

During the summer/fall season grizzly bears preferred shrubfields, burn shrubfields, slabrock, creekbottoms and ridgetops (Zager et al. 1983), snowshutes, timber and cutting units were avoided. The fruits of 8 plants were consumed during this season, of which *Vaccinium globulare* was predominant in scat samples (Mace and Jonkel 1980). *Amelanchier alnifolia* and *Sorbus* spp. were other important fruits. Zager et al. (1983) stressed the importance of wildfire created habitats to South Fork grizzly bears during the summer/fall season.

Table 21. Grizzly bear habitat use and availability, Northern Continental Divide Ecosystem.

Area/Habitat Component	Seasonal Use[abc]				
	Spring	Summer	Summer/ Fall	Fall	Annual
Mission Mountains (Servheen 1981):					
Snowchute/sidehill park	x	o		x	-
Snowchute/shrubfield	x	o		x	-
Sidehill park	o	o		o	o
Shrubfield	o	o		o	o
Timber sidehill park	o	o		o	-
Wet meadow	o	x		+	o
Slabrock alpine	x	+		+	o
Slabrock (mid or low elevation)	x	o		o	-
Talus/scree/rock	o	o		o	o
Riparian zone	+	o		+	+
Riparian zone/cutting unit	x	o		x	o
Road	o	x		o	o
Cutting unit	o	o		o	o
Timbered shrubfield	o	-		-	o
Timber	o	-		-	-
Marsh	x	x		x	x
Agricultural lands	-	-		x	-
Seep areas	+	+		+	+
East Front (Aune et al. 1986):					
Cutting units	x	x		x	x
Meadows	-	-		-	-
Roads	-	-		-	-
Sidehill park	o	-		-	-
Mountain grassland	-	-		-	-
Prairie grassland	-	-		-	-
Rock/talus/scree/rubble	o	o		-	-
Pinus flexilis savanna	-	-		-	-
Shrubfield	-	-		o	o
Snowchute	o	o		-	-
Populus spp. stands	+	+		+	+
Riparian shrub	+	+		+	+
Riparian complex	-	-		-	-
Closed timber	o	o		+	o
Open timber	+	o		+	o
Unclassified	o	o		o	o
Burns (all ages)	-	-		o	o

Table 21. Continued.

Area/Habitat Component	Seasonal Use[abc] Spring	Summer	Summer/ Fall	Fall	Annual
Habitat Series:					
Pinus flexilis	-	-		-	-
Pseudotsuga menziesii	+	+		-	+
Picea spp.	o	o		-	o
Abies lasiocarpa (lower elevation)	-	-		o	-
Abies lasiocarpa (upper-timberline)	+	o		+	+
Pinus contorta	o	o		-	-
Other	o	+		-	o
South Fork Flathead River (Zager 1980):					
Snowchute	+		-		
Sidehill park	o		o		
Shrubfield	o		o		
Meadow	o		o		
Slabrock	o		+		
Talus/scree	x		o		
Creek bottom	o		+		
Road	x		o		
Cutting unit	o		o		
Timber	-		-		
Ridgetop	+		+		

[a]Significance levels differ among areas.

[b]Seasonal dates differ among areas.

[c]+ = significantly used more than available, - = significantly used less than available, o = use not significantly different than available, x = not used.

Mission Mountains

Servheen (1983) described 19 habitat components (Table 21) in the Mission Mountains of Montana and conducted habitat availability and use analyses from radio-instrumented grizzly bears. Relatively low-elevation riparian zones and seeps were used more than expected during spring (15 April-15 June). Of the 19 components, only agricultural lands were used less than expected in the spring, although limited nocturnal telemetry data showed that such areas were traversed. Food productivity ratings per component showed that seep areas near the valley floor provided the greatest diversity of foods throughout the year. These perennially moist areas, characterized by *Picea* spp., *Lysichitum americanum* and *Athyrium felix-femina* represented 2% of the study area (Servheen 1981). Perennial graminoids, *Taraxacum* spp., and *Trifolium* spp. were primary spring foods. Livestock carrion, birds, beaver (*Castor canadensis*) and insects from rotten logs were other spring foods.

Seeps and alpine slabrock were used more than expected during the summer (16 June-30 August) with 24% of the summer telemetry locations in low-elevation seeps (Servheen 1983). Agricultural lands, timber and timbered shrubfields were used less than expected during summer. *Heracleum lanatum* and other Apiaceae were consumed during the late spring and early summer period. As snowpack decreased at higher elevations, avalanche chutes and sidehill parks became important foraging sites for the underground parts of *Hedysarum* spp., *Lomatium* spp. and *Erythronium grandiflorum. Equisetum* spp. was also consumed during the summer until the fruits of *Vaccinium* spp., *Amelanchier alnifolia, Shepherdia canadensis* and *Crataegus* spp. rippened. Army cut-worm moths (*Chorizagrotis auxiliaris*) were excavated from alpine talus slopes.

Autumn (1 September-den entry) habitat components important to Mission Mountain grizzly bears were riparian zones, wet meadows, seeps at low elevations and alpine slabrock. Domestic fruit orchards were also important during autumn. Domestic apples, plums and pears were the major autumn food resources (Servheen 1983).

East Front

Aune et al. (1986) reported on habitat availability and use information obtained from over 1000 radio locations collected along the East Front from 1977-1983. Grizzly bear seasonal use by elevation, aspect and slope was also reported. Several classification schemes were used to describe habitat use: forested habitat types (Pfister et al. 1977), grassland habitat types (Mueggler and Handl 1974), land types, photographic interpretive types (P-I) and habitat components. Grizzly bear seasonal habitat as described by these habitat types and components are briefly described below.

Following den emergence, bears used relatively low elevation habitats although much individual variation was noted (Aune et al. 1984, Aune et al. 1986). Three major taxonomic groups comprised important spring (April-June) foods: monocots, forbs and mammals. Important

monocot genera during spring were *Poa* and *Carex* spp. while important forbs included *Angelica* spp., *Lathyrus* spp., and *Taraxacum* spp. Domestic livestock carrion provided the largest source of protein. *Equisetum* spp. was also eaten during spring.

Grizzly bear use of the *Populus* spp. and riparian shrub components was significantly greater than random availability during spring (Table 21). *P. tremuloides* and *P. trichocarpa* stands were an important spring component and relatively mesic stands were used more extensively than those with relatively dry understories. Major spring grizzly bear activities in this component included grazing, carcass or carrion feeding and bedding (Aune et al. 1984). The riparian shrub component was often closely associated with *Populus* spp. stands, and included seeps, bogs, fens, glades and marshes. Such sites were often dominated by *Salix* spp. or *Betula* spp. with an understory of grasses and sedges. Grazing and bedding were major spring activites in the riparian shrub component.

Most spring bear activities within the closed and open timber components were bedding, traveling and denning. Relatively little grazing activity in closed timber was noted. The rock/talus/rubble/scree habitat component was also used during spring. Primary activities in this component included mating, bedding, traveling and root digging. Common underground food items included *Claytonia megarhiza, Allium* spp. and some *Hedysarum alpinum*. The prairie grassland habitat component was most extensively used in spring (Aune et al. 1984). The most common activity in prairie grasslands was traveling to preferred habitats although grazing and small mammal digging also occurred.

The summer diet of the grizzly bear in the East Front was more diverse than other seasons (Aune et al. 1984). Berries, graminoids, forbs, mammals and insects were major food categories at this time. Berry producing shrubs used by bears included *Arctostaphylos uva-ursi, Ribes* spp., *Amelanchier alnifolia, Shepherdia argentia* and *S. canadensis, Cornus stolonifera* and *Prunus virginiana*. Domestic oats (*Avena sativa*) were used heavily on occasion. Umbelliferae species were also important. The roots of *Lomatium cous* and corms of *Claytonia megarrhiza* were dug at higher elevations.

Five habitat components were major use areas during summer. The rock/talus/scree/rubble component was used for digging roots and small mammals. Timbered components (open and closed canopy) were selected by bears for feeding on berries and bedding (Aune et al. 1984). The *Abies lasiocarpa* habitat type series received 55% use during summer (Aune et al. 1984). The timber/burn component was also an important berry producing habitat. *Populus* spp. stands and riparian shrub components were important for general grazing, bedding and berry-feeding and were the only 2 components where use significantly exceeded availability (Aune et al. 1986).

Berries, the nuts of *Pinus albicaulis* and mammals were primary fall grizzly bear foods along the East Front. Once again bear use of *Populus* spp. stands and the riparian shrub component exceeded availibility. Use of open and closed timber components during fall also significantly exceeded availability (Aune et al. 1986). Typical activities in timbered components included securing pine nuts (*P. albicaulis*), bedding and denning. The *Abies lasiocarpa-P. albicaulis-Vaccinium scoparium* habitat type was especially important. Use of open timbered areas at all elevations correlated with directed foraging on *Shepherdia canadensis, Vaccinium* spp., *Prunus virginiana* and *Amelanchier alnifolia* berries.

North Fork

A synthesis of grizzly bear habitat use and food habits is not available for the North Fork of the Flathead River, however, yearly summaries of habitat use patterns are given by Rockwell et al. (1977) and Mace et al. (1979). Interim results of feeding-site analyses are given by the above authors and by Mealey et al. (1977). The food habits of North Fork grizzly bears was reported by Mace and Jonkel (in press).

The results of 64 radio locations obtained in 1977 suggest that south-facing sidehill parks, avalanche chutes and shrubfields are important during spring and early summer (Rockwell et al. 1977). Primary foods eaten at this time included *H. lanatum, Angelica* spp., *Osmorhiza* spp., *Equisetem* spp., and graminoids (Mace and Jonkel 1979, in press). Trapping and direct observation of bear sign suggested the importance of floodplain habitats for grazing, digging for *Hedysarum sulpherescens* and carrion feeding (Singer 1978). Home range comparisons between the United States portion of the North Fork (Rockwell et al. 1977, Mace et al. 1979) and British Columbia (Jonkel and McLellan 1979) suggested that there are 2 distinct habitat-use strategies in this area: some bears rarely leave floodplain areas throughout the active season, while others restrict their activities to mid-elevational, mountainous, habitats.

Timber, timbered burns, open burns and shrubfields were selected during summer and fall (Rockwell et al. 1977). The *A. lasiocarpa/Xerophyllum tenax-V. globulare* habitat type was particularly important. The fruit of *V. globulare* and *S. canadensis* were principal foods.

Cabinet-Yaak Ecosystem

The Cabinet Mountains were shaped by alpine and continental glaciation, have an elevational gradient of 610 m to 2664 m, and are under strong influence of Pacific airmasses. Valley bottoms to upper slopes are heavily forested (Kasworm 1985), with stands of *Abies grandis* and *Thuga plicata* at lower elevations, with extensive areas of *Pinus contorta* and *Pseudotusga menziesii*. Timberline habitats include *Larix lyallii-Abies lasiocarpa, Pinus albicaulis* type and the *A. lasiocarpa* series (Mace et al. 1978).

Detailed habitat-use studies of the small grizzly bear population in the Cabinet-Yaak Ecosystem were begun in 1983 (Kasworm 1984, 1985). Prior to this time, limited habitat data were collected and reported for several bears that were reintroduced into this Ecosystem (Mace et al. 1978). Kasworm (1985) provided interim habitat use data, from 105 radio locations, expressed as percent of locations occurring in 12 habitat components (Madel 1982). The Mixed Shrub Snowchute component was used most often during the spring, as was Closed Timber in over 10% of the samples. Other important spring components included Riparian Streams, open Timber and Graminoid Sidehill Parks (Kasworm 1986). Important habitat types in which these components occurred included *Thuga heterphylla-Clintonia uniflora* and *Abies grandis-C. uniflora*.

The Mixed Shrub Snowchute component was again most commonly used during summer, and the Mixed Shrub Burn and Closed Timber Components were also reported to be important. Over 40% of the summer components were within the *Abies lasiocarpa-Xerophyllum tenax* habitat type.

Major fall habitat use occurred in the Timbered Shrubfield and Closed Timber components. Fall habitat types used most frequently by bears were *T. heterphylla-C. uniflora, A. lasiocarpa-Menziesia ferruginea* and *A. lasiocarpa-X. tenax*.

Mace et al. (1978) described general habitat-use patterns of 2 reintroduced yearling bears in the Yaak portion of the Cabinet-Yaak Ecosystem. These yearlings spent the last 2 weeks of July in mesic portions of a subalpine basin within the *Abies lasiocarpa-Calamagrostis canadensis* habitat type. Field analysis of scats from this location showed that while the fruit of *Vaccinium globulare* was the dominant food, *Senecio triangularis, Veratrum viride* and *Angelia* spp. were also grazed upon. From July through August, radio locations indicated that these bears foraged extensively in *Vaccinium globulare-Rododendron albiflorum* dominated shrubfields. Mesic meadows dominated by sedges were also used (Mace et al. 1978).

Selkirk Ecosystem, Northern Idaho and Washington

Although grizzly bears occur in the Selkrirk Ecosystem in northern Idaho and Washington, population levels are believed to be low (U.S. Fish and Wildlife Service 1982). Almack (1986) investigated the movements, food habits and habitat use of 1 instrumented adult bear. The following discussion comes from that investigation.

The climate of the study area in northern Idaho is influenced by Pacific maritime weather patterns. Forest stands are dominated by amixture of *Pseudotsuga menziesii, Picea engelmannii, Abies grandis, Pinus contorta, A. lasiocarpa, Tsuga heterophylla, Thuga plicata, Larix occidentalis* and *Pinus monticola*. Almack (1986) deliniated 20 habitat components for the area (Table 22) from which availability and use measurements were obtained.

During spring, the instrumented bear fed on *Carex* spp., *Equisetum* spp., grasses, and the roots of *Claytonia lanceotata, Erythronium grandiflorum*, and *Lomatium* spp. Meadows, marshes and moist cirque basins were primary feeding sites (Table 22).

Vaccinium spp. and *Lonicera* spp. fruits were the dominant food items during the summer. *Liguisticum* spp. and *Equisetum* spp. were other common food items. These food items were secured in mixed shrubfields within a large burn.

Digging was the primary foraging activity in the autumn (Almack 1986). The underground parts of *Mitella breweri, Tiarella trifoliata* and *Lonicera* spp. were dug in old clearcuts and selection cuts. The instrumented bear also ate ants and earthworms (Class Oligochaeta). Almack (1986) documented the use of 8 food plants not found in previous food habits literature for North America.

Table 22. Availability and use of 20 habitat components by one instrumented grizzly bear in the Selkirk Ecosystem (Almack 1986).

Habitat component	Seasonal Use[a]			
	Spring	Summer	Autumn	Total
Alnus spp. shrubfield	-	-	o	o
Mixed shrubfield burn	o	+	o	+
Mixed shrubfield snowchute	o	o	o	o
Drainage forbfield	o	o	o	o
Timbered mixed shrubfield	o	-	-	-
Forbfield burn	o	-	-	-
Forbfield cutting unit	-	o	o	o
Open-timbered grass	-	-	-	-
Grass sidehill park	o	o	-	o
Mixed shrubfield	o	o	o	o
Rock	o	o	o	o
Marsh	o	o	o	o
New cutting unit	-	-	-	-
Riparian streambottom	-	o	o	o
Mixed shrubfield cutting unit	o	o	o	o
Vaccinium spp. shrubfield	o	o	o	o
Wet Meadow	o	o	o	o
Xerophyllum spp. sidehill park	-	o	o	o
Dry meadow	-	o	o	o
Closed timber	-	-	o	-

[a]+ = use significantly greater than available, o = use equal to available, - = use less than available.

Alaska

Kodiak Island

Kodiak Island is located southeast of the Alaska Peninsula in the Gulf of Alaska, and is characterized by fjord-like bays, interior mountainous terrain, cirques and alpine peaks (Atwell et al. 1980). The higest peaks retain snow thoughout the year and several small glaciers are found on the Island. The Island is under the influence of the Japanese Current and temperatures are mild. Fog, rain and drizzle are common maritime weather conditions.

The northeastern portion of Kodiak Island contains extensive stands of *Picea sitchensis*, not present elsewhere on the Island (Troyer and Hensel 1969, Atwell et al. 1980). River deltas often contain extensive stands of *Elymus arenarius* on relatively dry sites with adjacent intertidal vegetation dominated by sedges, most notably *Carex lyngbyaei* (Smith and Van Daele 1984). Atwell et al. (1980) stated that the most characteristic vegetation of the Island, from sea level to approximately 580 m was a complex of *Alnus crispa sinuata* and *Salix* spp. interspersed with lush grass and forb openings. Common herbs include *Heracleum lanatum, Veratrum viride, Angelica* spp., *Lupinus nootkatensis* and *Equisetum* spp. Patches of *Rubus spectabilis, Sambucus* spp., *Echinopanax (Oplopanax) horridus* are also present. Stands of *Betula papyrifera var. kenaica* and *Populus balsamifera* are common along river courses.

Alpine vegetation is most prominent on high peaks in the northwestern portion of the Island; 7 alpine plant communities have been recognized (Atwell et al. 1980). The Ericaceous Knolls and Hummocks, *Alnus* spp., and Willow Field-Subalpine Meadow communities were dominant in the area studied by Atwell et al. (1980). *Carex macrochaeta, H. lanatum, Empetrum nigrum* and *R. spectabilis* were characteristic species in these alpine communities.

The major rivers on the Island are important spawning areas for 5 species of salmon (*Oncorhynchus* spp.), steelhead (*Salmo gairdnerii*) and dolly varden trout (*Salvelinus malma*). The Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) is the dominant ungulate.

Clark (1957) presented a detailed analysis of seasonal food habits of the Kodiak bear based on stomach and scat content. More recent studies using radio telemetry have indentified specific foraging habitats. Berns and Hensel's (1972) telemetry studies showed that Kodiak Island bears in the Karluk Lake area used lowland, midland and upland habitats. Further telemetry studies in this area by Berns et al. (1980) and Barnes (1985) have more intensively evaluated these 3 elevational categories of habitat. Differential use of habitats by age, sex and reproductive status was reported (Smith et al. 1983, Barnes 1985).

After den emergence in early spring, some bears move to beaches to feed on seaweed and carrion (Clark 1957). Other early foods documented by Clark (1957) included tree conks (*Fomes applanatus* and *F. pinicola*), and *Boschniakia rossica*. Troyer and Hensel (1969) stated that herring eggs (*Clupea pallasii*) may be locally important in spring as well. Barnes (1985) determined that some bears remained at high elevations, fed rarely and selected areas of high resting and escape cover. Grazing in tidal-flats was also observed in the Terror Lake region by Smith and Van Daele (1984).

As snow receded in May, bears began consuming green vegetation. Clark (1957), Troyer and Hensel (1969), and Smith and Van Daele (1984) stated that low-elevation exposed slopes and beaches were important feeding areas. Tall Shrub (*Alnus* spp.) and Moist Herbaceous Meadow habitat types were used (Barnes 1985). Specific foods consumed at this time included *Calamagrostis canadensis, Hordeum brachyantherum, Elymus arenarius* and *Angelica lucida. H. lanatum* (Clark 1957) and *Populus* spp. cambium (Troyer and Hensel 1969) were also consumed. Limited use of alpine habitats, where they occurred, was also reported (Atwell et al. 1980). Eide (1965) and Troyer and Hensel (1969) discussed the extent of brown bear predation on domestic cattle on Kodiak Island during spring and autumn.

During summer, numerous bears are attracted to vegetation available in midland and upland habitats (Clark 1957), and individual intensive use of alpine habitats where available. Two alpine communities were recognized by Atwell et al. (1980) as being particularly important: the *Carex* spp.-Forb Meadow and Willow Field-Subalpine Meadow. Primary alpine foods included *Carex macrochaeta, A. lucida, Equisetum arvense* and *Lupinus nootkatensis*.

As spawning salmon became available, most bears abruptly moved to lowland habitats (Clark 1957, Troyer and Hensel 1969, Bernes et al. 1980, Smith and Van Daele 1984, Barnes 1985), however, the duration and intensity of feeding on salmon varied considerably among individuals, and some bears, especially females, ignored salmon (Berns and Hensel 1972, Smith and Van Daele 1984). The impact of brown bear predation on salmon populations has been debated in the literature (e.g., Clark 1959, Gard 1971).

Although fish are are still available in mid-August, bears began eating fruit, primarily *Sambucus* spp. (Clark 1957, Smith et al. 1984). The fruit of *O. horridus, Viburnum edule, R. spectabilis* and *E. nigrum* were also consumed. Midland shrubfields were primary foraging areas (Berns et al. 1980, Barnes 1984). Autumn food habits are characterized by both alternate and simultaneous use of fish and berries (Troyer and Hensel 1969, Berns and Hensel 1972, Smith and Van Daele 1984).

Interior Alaska

The primary grizzly bear food habits and habitat use studies in Interior Alaska were conducted in Denali (Mount McKinley) National Park (Valkenburg 1976, Stelmock 1981, Darling in press), located in the central Alaska Range. The predominant vegetation is a gradation of *Picea glauca*-hardwood forests, to moist and alpine tundra types (Stelmock 1981). The topography is typified by high mountain peaks with broad, glacial river channels. *P. glauca* generally occurs in isolated patches at lower elevations, valleys and mountain slopes are dominated by dwarf *Salix* spp. and *Betula nana*. Rivers and streams are bordered by relatively taller *Salix* spp. and *Alnus crispa* shrubs (Darling in press). Other shrubs in the Park include *Shepherdia canadensis, Vaccinium uliginosum, V. vitis-idaea*, and *Empetrum nigrum*. Moist sedge-dominated tundra may be found on northern and east-facing slopes, while drier tundra typified by *Dryas octapetala, Cassiope tetragona*, and *Salix reticulata* are found on southern slopes and at relatively higher elevations. Ungulates present include *Ovis dalli, Rangifer tarandus* and *Alces alces*.

Stelmock (1981) described grizzly bear habitat use patterns using a 5 level vegetation hierarchical system (Viereck et al. 1982). Bear habitat use was quantified using "bear-unit-hours" per hour of observation in 2 study sites: Toklat River and Sable Pass. Darling's (in press) research was developed to investigate habitat use differences between family units and lone individuals and to quantify the concept of "nursery habitats." Darling (in press) concluded that while some differences in habitat use among cub families, yearling families and single bears was evident, the ability to quantifiy selection was hampered by annual vagaries in habitat productivity.

The roots of *H. alpinum* and the over-wintering fruit of *E. nigrum* were important spring foods in Denali National Park although scat analysis and direct observations showed that use of these 2 items varied locally. These and other spring foods were obtained from mat and cushion tundra, tall and low shrublands and various forest types (Stelmock 1981). The *D. octopetela-E. nigrum* mat/cushion types were extensively selected for available over-wintered berries while the *S. alaxensis-H. alpinum* was typically seclected for roots (Table 18). Bears grazed on *Calamagrostis canadensis* near roads and along exposed streambanks within the *Arctagrostis latifolia-E. arvense* type.

During summer, bears confined their foraging activities to very specific vegetation types which provided an abundance of favored foods. To accomplish this, bears constantly shifted to habitats of variable elevation, aspect and moisture levels. Tall shrublands, low shrublands, herbaceous and sedge-grass tundra types were selected during summer. Bears grazed extensively on grasses, sedges, *Equisetum* spp., and *Boykinia richardsonii* during this period. These foods were secured near perennial snow accumulations (*A. latifolia-B. richardsonii* type). Additionally, flowers of *Oxytropis viscida* were eaten when encountered. Arctic ground squirrels were actively dug from their chambers and fruits were consumed as they ripened.

E. nigrum and *S. canadensis* berries were the most important fall diet item and were both generally found in the same vegetation types within low shrublands and mat/cushion tundra (Stelmock 1981). In areas were *Shepherdia* spp. shrubs were uncommon, Arctic ground squirrels constituted a major fall diet item.

Stelmock (1981) noted that bears often left a particular vegetation type before food resources were depleted and travelled sinuously during all seasons. He attributed this behavior to procuement of animal matter, seasonal changes in food availability and curiosity.

South Central Alaska

Brown bear studies in south central Alaksa have been conducted in both coastal (Campell 1985) and interior habitats (Miller and McAllister 1982). Interior studies have focused on the effects of the proposed Susitna hydroelectric facility and coastal investigations were designed to assess the impacts of brown bears on waterfowl nesting success. Limited food food habits data are available for this area. Interior habitat selection on an annual basis can be inferred from Table 23. Brown bear predation on moose calves has been investigated by Ballard et al. (1981). In this study, brown bears were responsible for 79% of the radio-instrumented calf mortality.

Table 23. Number of radio-instrumented brown bear observations in different habitat types in the Susitna Hydroelectric Project study area (from Miller and McAllister 1982).

Vegetation type	No. of brown bear relocation hits
TUNDRA	
Mat and cushion	42
Sedge-grass	19
Sedge-shrub	14
Wet sedge-grass	4
CONIFER FOREST	
Open, Picea mariana	51
Woodland, Picea mariana	46
Open, Picea glauca	22
Woodland, Picea glauca	17
MIXED FOREST	
Closed conifer-deciduous	28
Open conifer-deciduous	8
DECIDUOUS FOREST	
Closed, Betula spp.	2
Open, Betula spp.	2
Populus spp.	0
SHRUBLANDS	
Closed tall	9
Open tall	39
Betula	48
Salix spp.	13
Low shrub	83
GRASSLANDS	1
OTHER	
Rock	19
Snow and ice	0
Lakes	1
Disturbed	0
River-gravel bar	2
Herbaceous	1
	471

The brown bear investigations in coastal habitats of south central Alaska are on-going, and therefore results presented here are preliminary. Campbell's (1985) study area was situated on the Copper River between the Heney Range and the Chugach Mountains. This area contains approximately 190 sq. mile of deltic plain with braided streams fed by adjacent glaciers. Montane elevations of approximately 1000 m occur in the area. Vegetation types on the delta were disrupted by the 1964 earthquake. Coastal plant communities are dominated by freshwater *Carex* spp. meadows interspersed with *Alnus crispa* and *Salix* spp. shrubfields. Tall shrub and shrub-bog habitats (*Myrica gale, Menyanthea trifolicata*) are more prevelant on inland sites (Campbell 1985). *Alnus-Picea* spp. communities become dominant between 4 and 14 miles inland. Stands of *Populus balsamifera* interspersed with *Alnus* spp. and *Oplopanax horridus* are present in some locations.

Brown bear habitat use and food item selection data are available only for the May-June period (Campell 1985). Food habits data for this period are based on 16 scats in which *Equisetem* spp. and grasses/sedges were most predominant. Miscellaneous vegetation and waterfowl egg fragments were also identified. These scats showed that bears in this coastal habitat consumed moose, beaver and microtines.

Differences in the distribution between 2 age classes was observed during the May-June period although habitat selectivity was similiar (Table 24). Immature bears were located more often in coastal habitats while adults occupied habitats further inland.

Although telemetry data are limited for the summer and fall period, bears continued to use the delta to some extent with a general movement inland during August and September. During this period bears moved to spawning salmon streams and took advantage of this food source.

Alaska (Kenai) Peninsula

No intensive brown bear habitat studies have been conducted in the Alaska Peninsula, however, general trends in food item and habitat selection are presented for several areas. Predation intensity on marine bird eggs is presented by Bailey and Faust (1984); salmon/bear relationships are reported by Gard (1971), Egbert (1975) and Luque and Stokes (1976) among others; and, evidence of predation on moose on the Peninsula is given by Franzmann et al. (1983). Bevin et al. (1984) provided an overview of major food items available on the Alaska Peninsula. Moose and salmon are important sources of protein. *Equisetum* spp. use is inferred from other areas as this food is widespread on the Peninsula. Important fruit species include *Rubus spectabilis, Oplopanax horridus, Viburnum edule, Empetrum nigrum* and *Vaccinium* spp.

Glenn and Miller (1980) described the seasonal movements of marked bears in the Black Lake area. After leaving their winter dens, bears generally moved from mountainous subalpine areas onto coastal plains. Bears of all age and sex classes were attracted to Bristol Bay to consume dead gray whales (*Eschrichtius robustus*), walruses (*Obobenus rosmarus*) and harbor seals (*Phoca vitulina*). Some predation on moose and caribou calves was reported (Glenn and Miller 1980).

During summer, bears in the Black Lake area moved to salmon spawning streams in the foothills of the Aleutian Range. Salmon feeding generally followed the spawning chronology of particular salmon species and began in early July and, at times, continued into late November.

Near the end of August, bears began to disperse from salmon streams and moved into the subalpine *Alnus* spp. zone and alpine areas (Glenn and Miller 1980) to feed on berries (species not specified). Seasonal differences in habitat use and use of cover by different age and sex classes was apparent from the data.

Southeast Alaska

Brown bear habitat studies in the northern Alexander Archipelago have been conducted by Schoen and Beier (1983,1986) and by Schoen et al. (in press b). The objective of this investigation was to determine seasonal movements and habitat use of brown bears in relation to logging and mining activities on Admiralty and Chichagof islands. Vegetation in these study areas is dominated by 2 major habitat types; temperate rain forest and alpine tundra (Schoen et al. in press b). The forested zone is interspersed with poorly drained and open muskeg habitats. *Tsuga heterophylla, Picea sitchensis* and *Chamaecyparis nootkatensis* are dominant confiers. Numerous small lakes and tidal flats are situated at low elevations, and numerous salmon spawing streams are present.

Schoen and Beier (1986) divided habitat use into 4 seasonal categories; spring (emergence-15 May), early summer (16 May-15 July), late summer (16 July-15 September) and fall (16 September-denning). Admiralty Island bears used higher elevation habitats than Chichagof bears during spring and early summer. Schoen and Beier (1986) believed that this difference reflected a greater availability of alpine and subalpine habitats on Admiralty. During summer, bears on both islands used low elevation habitats coinciding with the period of fishing for salmon on coastal streams (Table 25).

Habitat use and availability on Chichagof Island was reported by Schoen and Beier (1986). Upland old-growth was used in proportion to availability except during early and late summer when use was less than availability. Riparian oldgrowth use exceeded available habitat during late summer. In spring, avalanche slopes were preferred. Clear cut areas and alpine/subalpine habitats were avoided on Chichagof throughout the year (1% of locations). Several other parameters of brown bear habitat use were also reported by Schoen and Beier (1986). These included: seasonal elevation, percent slope, aspect, topography, canopy cover, soil drainage and timber volume.

McCarthy (1986: Appendix B in Schoen and Beier 1986) has provided interim food habits results for the Admiralty Island study area (Hawk Inlet). Twenty-eight food items were found in scats collected in 1984. *Carex* spp. was the

Table 24. Brown bear use of habitat types on the west Copper River, May-June 1984 (from Campbell 1985).

		Percent utilization						
		Lowland Delta				Montane		
Age class	(n)	Forest (%)	Tall Shrub (%)	Meadow (%)	Mudflat (%)	Forest (%)	Tall Shrub (%)	Meadow (%)
All	295	14.6	58.6	15.3	0.7	3.7	5.8	1.4
Adult	195	17.9	61.5	11.8	0	4.1	3.1	1.5
Immature	100	8.0	53.0	22.0	2.0	3.0	11.0	1.0

Table 25. Brown bear habitat use on Admiralty and Chichagof Islands, Alaska during 1984 (from Schoen and Beir 1986)

	Percent utilization[a]							
	Spring		Early Summer		Late Summer		Fall	
Habitat Type	A	C	A	C	A	C	A	C
Old-growth forest	45	50	35	33	22	18	30	45
Riparian old-growth	13	4	4	6	32	57	31	18
Subalpine	2	0	12	6	16	1	4	0
Alpine	9	0	18	0	17	1	9	0
Avalanche slope	23	36	23	40	7	8	15	13
Rock	6	0	5	2	0	0	5	5
Road	0	4	0	0	0	0	0	0
Beach/tidal flat	2	4	1	6	3	0	1	0
Second growth	0	0	0	4	0	0	0	0
Garbage dump	0	0	0	0	0	7	0	16
Stream	0	0	1	0	4	8	4	3
Clear cut	0	4	0	2	0	1	0	0
(n)	64	28	175	48	76	119	166	38

[a]A = Admiralty, C = Chichagof

most important food to both high and low elevation bears during May and June. Low elevation bears consumed *Lysichitum americanum* and *Equisetum* spp. while grasses and sitka black-tailed deer (*Odocoileus hemionus sitkensis*) were important to bears using higher elevation sites.

Salmon and *Carex* spp. were heavily used during July and August (McCarthy 1986). The berries of *Oplopanax horridus* and *L. americanum* were consumed following feeding at salmon runs. *Ribes* spp., *Carex* spp., and *O. horridus* berries were eaten by high elevation bears on avalanche slopes.

Arctic Alaska

Habitat and food habits related investigations on the northern slope of the Brooks Range have been conducted by Gebhard (1982), Hechtel (1985) Phillips (1985), and Curatolo and Moore (1975). Although specific vegetation descriptions differ somewhat among study areas, the overall habitat types availabile are similiar. The north slope area has been described in terms of 4 general physiographic zones: northern plateaus, Arctic mountains, Arctic foothills and Arctic coastal plains (Phillips 1985). The coastal plain is characterized by relatively flat and poorly drained wet meadows dominated by sedges and associated shrub species. *Eriophorum vaginatum* tussock communties are common in the foothill region on moderately-drained slopes (Curatolo and Moore 1975). The Arctic mountain zone is characterized by wide river valleys and rugged (glaciated) mountains where vegetation is limited due to permafrost, frost action and rapid erosion of slopes. River valleys are typified by braided river channels, *Salix* spp. flats and large expanses of non-vegetated gravel bars.

The seasonal food habits and foraging behavior of north slope foothill bears was described by Hechtel (1985). During spring, the roots of *Hedysarum alpinum* and *Oxytropus borealis* were dug extensively by bears in mat/cushion types, *Dryas* spp. tundra and riparian areas (Hechtel 1985). Other major spring foods included *E. vaginatum* floral parts, over-wintering *Arctostaphylos rubra* berries, grasses/sedges, mictotines and Arctic ground squirrels (*Spermophilus parryii*). Caribou were consumed to a lesser degree at this time. Tussuck tundra, and tall and low shrublands were used by bears in the Arctic National Wildlife Refuge for *Hedysarum* spp. digging (Table 26) (Phillips 1985). In the eastern Brooks Range, river valley habitats were used more often than mountainous areas during spring (Table 27) although home range location in relation to these types differed among bears (Curatolo and Moore 1975).

Major summer vegetal foods of the barren-ground grizzly included *Boykinia richardsonii, Equisetum arvense*, and grasses/sedges. Ground squirrels and roots continued to be eaten although the incidence of root digging decreased (Hechtel 1985). Favored foraging areas for these items in Hechtel's study were moist herbaceous meadows, ground squirrel mounds and snowbank communities. Early summer use of tussock tundra, mat/cushion tundra, and shrublands was observed by Phillips (1985) for those bears digging roots. Herbaceous tundra was used in later summer (Table 26) in the Arctic National Wildlife Refuge by bears feeding on *Equisetum* spp., grasses and *Boykinia* spp. Preference for more mountanous habitats was reported by Curatolo and Moore (1975) (Table 27).

Table 26. Index of grizzly bear vegetation type use (level II) in the Arctic National Wildlife Refuge, 1982-1983 (from Phillips 1985).

	Spring	Summer			Fall	
Vegetation Type (Level II)	25 May-7 June	22 June-5 July	6 July-19 July	20 July-2 Aug	3 Aug-16 Aug	17 Aug-29 Aug
Sedge-grass tundra	0.1	1.4	1.4	1.1	1.1	0.5
Herbaceous tundra	—	5.8	4.2	12.9	32.7	0.2
Tussock tundra	1.9	0.5	0.6	0.6	0.1	0.2
Shrub tundra	—	3.2	4.1	2.2	1.4	2.8
Mat/cushion tundra	0.2	0.1	0.2	0.4	1.0	1.5
Tall shrubland	1.3	4.6	0.6	4.1	1.1	2.4
Low shrubland	8.0	0.7	0.2	0.2	0.4	8.4

Table 27. Seasonal observations of 10 grizzly bears in 2 habitat types, 1984 (from Curatolo and Moore 1975).

Season	Percent of observations		
	River Valley	Mountain	(n)
Spring (10 May-22 June)	68	32	66
Summer (23 June-29 July)	20	80	69
Early Fall (30 July-3 Sept)	43	57	53
Late Fall (4 Sept-1 Oct)	54	45	42

Roots, berries and ground squirrels constituted major fall food items (Hechtel 1985). The fruit of *A. rubra* was most important although *Vaccinium uliginosum, V. vitis-idaea*, and *Empetrum nigrum* were present in the study area. Principal foraging areas in the Arctic National Wildlife Refuge during fall were mat/cushion tundra, shrub tundra and river shrublands (Phillips 1985) where roots and berries were consumed. Bears in the eastern Brooks Range appeared to be equally distributed between river valley and mountain habitats (Curatolo and Moore 1975).

Caribou did not appear to be a major food item in the western Brooks Range (Hechtel 1985) although carcasses were consumed when available. Reynolds (1980) believed that bears did not move far to hunt caribou, but did take advantange of this protein source when present within a bear's normal home range. The relationship between bears and ground squirrels was complex, and bear distribution and habitat use was correlated to this food source. Similar ecological requirements between bears and squirrels for preferred feeding and digging sites was felt to be the primary association (Hechtel 1985).

Canada

Coastal British Columbia

Primary grizzly bear habitat studies in British Columbia have been conducted in the Kimsquit River basin (Hamilton and Archibald 1986) and the Knight Inlet area (Wray and Hebert 1975, Smith 1977). Grizzly bear research in each area was prompted by the potential impacts of extensive logging activity occurring in the coastal zone.

Both study areas contain an upper valley and a lower watershed with heavy rainfall on the outer coastline decreasing toward the mountainous interior. Climate in the upper valleys is influenced by coastal factors while the lower watershed has been termed a "coast-interior transitional climate." *Tsuga heterophylla* is the primary climax species, although it may be co-dominant or replaced by *Pseudotsuga menziesii, Pinus contorta, Thuja plicata, Picea sitchensis* and *Abies amabilis* on certain sites. In the lower valley, deciduous forests occupy considerable area (Banner et al. 1986) typically dominated by *Alnus rubra* and *Populus* spp. Ten floodplain *Picea* spp.-*Oplopanax horridus* associations were described by Banner et al. (1986). Shrub dominated vegetation is found in avalanche tracts, riparian areas, organic bog fringes, subalpine and recently logged areas. Bedrock, icefields and talus slopes are present in the alpine tundra zone. The Kimsquit River is an important spawning area for pink (*Oncorhynchus gorbusha*), sockeye (*O. nerka*) and chum (*O. keta*) salmon.

Smith (1978) divided the Sims Creek (Knight Inlet) study area into 6 broad categories: areas clearcut between 1969-1974, selective cuts between 1950-52, natural early successional areas, near-climax forest, swamp and tidal areas. Based on plot data, Smith estimated habitat quality, food availability and cover quality for each category. Grizzly bear hunting in this area may reduce bear use of logged areas.

Preliminary habitat-use studies (Hamilton and Archibald 1986) suggest that low elevation habitats are important to grizzly bears. Sixty-four percent of 112 feeding activity records were in the floodplain *Picea* spp.-*Oplopanax horridus* association and, variations of this association. Floodplain habitats are important because of their proximity to salmon spawning channels and because a high diversity of food plants exist in the mosaic of floodplain comunities (Hamilton and Archibald 1986, Banner et al. 1986).

Verified foods of Kimsquit valley grizzly bears (Hamilton and Archibald 1986) include 7 fruit bearing shrubs and herbs (e.g., *Cornus sericea, Lonicera involucrata, Rubus* spp., *Vaccinium* spp. and *Viburnum edule*). Bears in this area dig the roots of *Osmorhiza chilensis* and *Angelica genuflexa. Heracleum lanatum*, grassses, sedges, and *Equisetum* spp. were herbaceous foods use by grizzlies. Bears relied heavily on salmon.

Smith (1978) examined 175 scats from the Sims Creek area. The succulent shoots of *R. spectabilis* and grasses were primary vegetative components of scats. As fruits ripened during summer, a shift in diet to the fruit of *R. spectabilis, Vaccinium* spp., *Rubus idaeus*, and *R. leucodermis* was evident. *Lysitchiton* spp. was not a major item in scat collections (Smith 1978) although Wrey and Hebert (1977) cite this plant as an important food. Salmon became important in August. Lloyd et al. (1977) provided evidence of bears securing salmon eggs from redds that were exposed by low water levels.

Interior British Columbia

Glacier National Park

Mundy and Flook (1970) investigated grizzly bear habitat use and food habits in Glacier National Park, British Columbia. Precipitation from Pacific airmasses is greater in this Park than in the Rocky Mountains to the east. Habitat descriptions provided here were detailed by Butter (1941).

The study area was mountainous and heavily forested. Dominant coniferous species, by increasing elevation, include: *Tsuga heterophylla, Thuja plicata, Pseudotsuga menziesii, Picea* spp., *Abies lasiocarpa* and *Pinus albicaulis*. Forest openings suport numerous herbaceous and shrub species including *Rhododendron* spp., *Vaccinium membranaceum, V. ovalifolim, Ribes* spp. and *Rubus parviflora*. Openings along streams contain *Salix sitchensis, Alnus sitchensis, Sambucus* spp. and *Heracleum lanatum*.

Erythronium grandiflorum is found in open avalanche tracks. Alpine vegetation is also represented in the study area.

Current grizzly bear habitat use information in Glacier National Park is based on direct observations of Mundy (1963) and a synopsis of warden obervations grouped into 3 broad categories of habitat: forest, avalanche slope and alpine meadow. Data suggest that grizzly bears use avalanche slopes and forest predominantly in the spring and early summer with increased use of alpine meadows in July and August. An autumn return to avalanche slopes was correlated with ripening of berries at lower elevations. During 1961-1962 bears were attracted to, and secured food from, 4 garbage dumps. The distribution of numerous bears in the Park was related to the location of these dumps.

Studies of the natural food habits (excluding dump foods) of Glacier National Park bears, showed that ungulate carrion is most important in the spring Grasses sedges, and *Equisetum* spp. were prominent food items during the spring and early summer while *Vaccinium* spp. was eaten mid-summer throughout autumn. *Sorbus* spp. and *Ribes* spp. were other fruit shrubs eaten by bears. Warden observations suggest that the roots of *Hedysarum* spp. were eaten as well.

Columbia Mountains

Simpson et al. (in prep) recently completed studies on grizzly bear ecology in the Columbia Mountains, Columbia River Basin. Situated north of Revelstoke, the study area lies between the Monashee and Selkirk mountain ranges. The topography of the Columbia Valley is U-shaped with steep glacially scoured valley walls, resulting in the formation of avalanche slides (Simpson et al. in prep). The Columbia Mountains lie within the Interior Wet Belt and 3 broad zones of vegetation are present (Krajina 1969). The Interior Cedar Hemlock Zone supports a dense coniferous forest. Above this Zone, the *Picea engelmannii — Abies lasiocarpa* parkland is characteristic. Alpine Tundra covers approximately 27% of the study area above 2300 m. South and west facing slopes that burned in the 1930s and 1940s support *Vaccinium* spp., *Rubus* spp., *Amelanchier alnifolia* and *Berberis aquifolium*. Some higher elevation logged areas also contain berry producing shrubs (Simpson et al. in prep).

Avalanche paths, valley bottom meadows, riparian areas and alpine parkland-tundra areas are the primary sites of grasses, sedges and succulent herbs. Ungulates include moose caribou and a small population of mule deer (*Odocoileus hemionus*).

Grizzly bears of the Columbia Mountains were efficient as predators and scavengers, depending on mammals during early spring (Simpson et al. in prep.). Predation and scavenging on moose, mule deer and caribou was apparent. Porcupines (*Erethizon dorsatum*), beavers (*Castor canadensis*), mountain goats (*Oreamnos americanus*) and small rodents were also eaten.

In spring, instrumented bears moved to the Columbia Valley and fed principally on *Trifolium* spp., grasses, and *Equisetum* spp. Two instances of directed foraging on *Pachistima myrsinites* were observed. Closed forests were considered indirectly important to grizzly bears because such areas were essential to ungulates which bears consumed. Logged areas did not produce plant foods attractive to bears in the spring (Simpson et al. in prep.). During the latter part of spring, avalanche paths and tributary riparian areas greened up and bears moved to these habitats (Table 28). Plant foods on avalanche paths included *H. lanatum* and *Claytonia lanceolata*. *H. lanatum* use increased in late June. *Vaccinium* spp. comprised the bulk of autumn diet, however, the fruit of *Oplopanax horridus* and *Chimaphila umbellata* were also frequently eaten by bears in forested areas. *Hedysarum* spp. and *Shepherdia canadensis* rarely occurred in the study area and were not food items.

Differences in habitat selection among individuals or between sexes, was not observed, however, no females with young were instrumented (Simpson et al. in prep.). Strong selection towards avalanche paths occurred in spring and summer. Cedar-hemlock forests and riparian zones were also key spring habitats. The cedar-hemlock forests produced *Erythronium grandiflorum, H. lanatum, C. lanceolata* and *Equisetum* spp.

Immature forests and slash areas were either avoided or used as expected as cover or for bedding. Bears left avalanche paths in the summer and foraged primarily in parklands and burns. Seventy-five percent of observed bedding areas were within 100 m of feeding sites.

Table 28. Seasonal habitat selection in the Columbia Mountains (Simpson et al. in prep).

Habitat component	Season[a] Spring	Summer
Valley bottom cedar/hemlock	+	o
Spruce/balsam forest	+	+
High elevation types	o	o
Avalanche paths	+	+
Logging slash	+	o
Burns	o	+
Immature forests	o	+
Riparian	+	o
Alpine tundra	+	+
Barren areas	+	+

[a] + = use signifcantly different than available at $p<.05$.
o = use not significantly different than available.

Canadian Rockies

Grizzly bear habitat and food habits studies in Banff National Park were conducted by Hamer and Herrero (1983b, 1986). The food habits of grizzly bears in Jasper National Park were discussed by Pearson and Nolan (1976) and Russell et al. (1979). Grizzly bear foraging habitat and food item selection in the Akamina-Kishinena drainages (Flathead River) of southern British Columbia were reported by McLellan (1986). A food habits study in southern British Columbia (Lloyd and Fleck 1977) did not distinguish between black and grizzly bear scats and therefore is not included here. An intensive habitat investigation in the Highwood Valley was conducted by

Wielgus (1986). A reconnaissance of habitat, distribution of foods and feeding evidence were reported by McCrory and Herrero (1981) in the Highwood area (Kananaskis Country) of Alberta.

Banff and Jasper National Park

Research by Hamer and Herrero (1983b) in Banff National Park, and by Russell et al. (1979) in Jasper National Park was conducted in the relatively arid eastern and western slopes, respectively, of the Front Range of the Rocky Mountains. Climate is generally continental, with winter chinook winds. The vegetation of the Banff area is comprised of 2 major zones; the *Picea* spp. — *Abies lasiocarpa* forest zone, and the alpine zone (2200-2300 m) (Ogilvie 1976). Fire-successional *Pinus contorta* is the characteristic conifer on warmer slopes of the subalpine forest zone, with *Picea* spp. and *A. lasiocarpa* occurring in more moist habitats. *Larix lyallii* is found near the treeline. Because of climate and topography, extensive stands of even-aged *P. contorta* do not occur, rather there exists extensive areas of mountain grassland meadows or *Shepherdia canadensis. Betula glandulosa-Salix* spp. — *S. canadensis* shubfields are widespread at lower elevations.

The alpine zone was unimportant as foraging habitat in Banff National Park (Hamer and Herrero 1983b). With the exception of *Equisetum arvense*, major foods were secured in a variety of open and seral vegetation types. Habitat use as related to major food items was reported by Hamer and Herrero (in press) for Banff and is summarized in Table 29.

Hedysarum alpinum and *H. sulphurescens* roots were most important in April, May, June, September and October although summer use was evident. *H. alpinum* roots were secured primarily in mesic to subhydric willow shrubfields below 2000 m. *H. sulphurescens* roots were dug in mesic to xeric, steep meadow slopes. These dry meadows were above 1900 m where 66% of the records were on southeastern to western aspects.

Bears selected digging habitats of increasing elevation as spring progressed. *Equisetum arvense* was important to Banff bears from June through August, and were found in mesic to hydric habitats of moderate slope. Riparian areas such as seeps, springs and streamsides were primary foraging sites.

Contrary to other major plant foods, *E. arvense* was often secured in mature forest types. The elevation of *E. arvense* foraging activity also increased through the summer, as bears preferred immature stems having a high nutritive value. Information on graminoid foraging sites limited because feeding evidence was difficult to discern (Hamer and Herrero in press a).

Open, immature forests created by wildfire were foraging sites for the fruit of *V. scoparium* and *V. myrtillus*. Such sites were on east-facing slopes were vegetation regenerated slowly (Hamer and Herrero in press a). *S. canadensis* berries were eaten in late summer and autumn on south-facing slopes; use was inversely related to *Hedysarum* spp. use during the later seasons. The seasonal nutritional value of these foods has been reported (Hamer and Herrero 1983b).

Southern British Columbia

McLellan's (1984) study area in the extreme southeastern corner of British Columbia (and portions of Glacier National Park, Montana) was situated primarily within the dry *P. engelmannii-A. lasiocarpa* biogeoclimatic zone (Krajina 1965). *P. albicaulis* is found at higher elevations with alpine tundra vegetation found at highest elevations in the Clark Mountains. Most of McLellan's study area is within the *A. lasiocarpa* habitat type of Pfister et al. (1977), although *Picea* spp. and *Pseudotsuga menziesii* types are also present. Natural fire dramatically altered the study area in the late 1800s and early 1900s.

P. contorta dominates lower elevations adjacent to the North Fork of the Flathead River and its tributaries. The wide valley bottom is of a gently rolling topography with small ridges, and mature *Picea* spp. stands occupying moist habitats. Intensive logging has occurred at lower to mid-elevations in response to spruce bark beetle (*Dendroctonus obesus*) and mountain pine beetle (*D. ponderosae*) epidemics. Communities of *Hedysarum sulphurescens* occur on sandbars. *Shepherdia canadensis, Cornus stolonifera* and *Rhamnus alnifolia* are conspicuous shrubs in

Table 29. Vegetation types associated with feeding activity for 11 major foods, Banff National Park. Highest ranking vegetation types per food item only (from Hamer and Herrero in press).

	Food								
Vegetation Type	Hedysarum alpinum	Hedysarum sulphurescens	Arctostaphylos spp.	Graminoids	Equisetum arvense	Oxyria digna	Heracleum lanatum	Shepherdia canadensis	Vaccinium spp.
Salix spp. shrubfields	x	x		x	x	x	x	x	
Picea/Salix spp.	x							x	
Picea spp./Ledum glandulosum	x								
Bromus/Festuca spp. meadow types		x	x	x			x		
Shepherdia/Bromus spp. shrubfield		x	x	x					
Picea/Equisetum spp.					x	x			
Wet meadows					x	x	x		
Picea or Pinus spp./ shepherdia								x	
Picea or Pinus spp./ Vaccinium scoparium									x

the floodplain. *Vaccinium globulare* occurs in post-fire shrubfields at higher elevations.

McLellan (1981) presented habitat use and availablity data obtained from 10 grizzly bears monitored in 1981 (Table 30) and described 4 seasonal habitat use patterns (McLellan 1986). During early spring, timber is the most commonly used habitat component. *Hedysarum* spp. is unevenly distributed within the timber component and is used as food. Grizzly bear predation and scavenging on elk (*Cervus elaphus*), deer (*Odocoileus* spp.) and moose occur most often in timber because of ungulate concentrations there. Snow-tracking records of McLellan (1986) show that during the first 3 weeks of April some bears travel extensively through timber, only rarely eating or defecating. Ungulates were the primary diet item from April through May (McLellan 1981).

In mid-May, vegetation began to green-up and use of timbered habitats was reduced. Root digging still occurred and succulent vegetation appeared in the diet. Not all grizzly bears occupied early spring and summer ranges in the valley; some individuals foraged in upland riparian zones and avalanche chutes (McLellan 1982). Dominant foods during the spring included *Equisetum* spp., *Angelica* spp., *H. lanatum* spp. and grasses/sedges. Early ripened berries of *S. canadensis* were consumed in July.

During the summer berry season, timber was rarely used (McLellan 1986), and at this time, bears foraged on *Vaccinium* spp. in open to open-timbered burn shrubfields (McLellan 1981). Other fruits eaten at this time were *S. canadensis, R. alnifolia* and *Crataegus* spp. From the end of the berry season to den-up (autumn), scat analysis showed that *Trifolium* spp., *Taraxacum* spp., roots and grasses were important. Hunter-killed or crippled ungulates and gut piles were a major source of protein (McLellan 1986).

Table 30. Habitat component availabity and use for 10 grizzly bears in southern British Columbia (from McLellan 1981).

	Seasonal Use[a]		
Component	**Spring**	**Summer**	**Fall**
Timber	-	-	-
Open timber	-	-	-
Clear cut	-	-	-
Ridgetop	-	+	-
Riparian	+	-	+
Slabrock	-	+	+
Snowchute	+	+	-
Meadow	+	-	+
Burn	-	+	-

[a]+ = habitat use exceeded availability, - = use of habitat was less than available (no statistical tests conducted)

Highwood Valley, Southern Rocky Mountains

Wielgus (1986) reported habitat use/preference results and developed a habitat prediction model for the Highwood Valley region. Habitat preference by instrumented animals was inferred by comparisons between random habitat points and radio location points. Logistic regression techniques were selected to discriminate between random and radio location points and to develop a predictive model of habitat use (Wielgus 1986). Habitat variables used were forest cover type, percent canopy closure, forest stand age, mean stand height, elevation, aspect, slope, distance to free water, distance to slope greater than 45 percent, closest stand characteristics and distance to closest stand. Four forest cover types were used: alpine, early seral, pine dominant and spruce dominant (Wielgus 1986). Two hundred eighty-eight scats were analyzed for food habits inferences.

The study area selected by Wielgus (1986) was rugged mountain terrain along the Continental Divide, exhibiting continental climate situated within a rainshaddow of the interior mountains. Biogeoclimatic zones of the area included the subalpine and alpine zones and the *Abies lasiocarpa-Picea engelmannii* forest zone (Bickerstaff et al. 1981). Jacques (1980) identified 3 subszones of the subalpine forest. The first low-elevation subzone was dominated by *Picea* spp. with intrusions of *Populus tremuloides*. The mid-subzone was codominated by *Picea engelmannii* and *A. lasiocarpa. A. lasiocarpa* dominated the high-subzone with interspersed local occurrences of *Larix lyallii* and *P. albicaulis. P. contorta* stands occurred throughout the study area as a seral stage of the *Picea* spp.-*Abies* spp. forest.

Grizzly bear use of the Highwood Valley was stratified by 5 seasons: spring, early summer, late summer, fall and late fall (Wielgus 1986). Frequency of occurrence and percent composition data indicated that *Hedysarum sulpherescens, H. alpinum* and grasses were the major spring food plants. *Hedysarum* spp. use continued into early summer; use of *Deschampsia caespitosa, Vicia americana, Equisetum* spp. and *Heracleum lanatum* also increased in early summer. Analyses of spring habitat use indicated that male grizzly bears preferred pine and early seral types (Table 31), using relatively young, dense stands heavily. Alpine and *Picea* spp. sites were used less than as available. Female grizzly bear habitat use during this season was similiar to males although females tended to use old *Picea* spp. cover types more frequently.

During early summer, males preferred old, dense, *Pinus* spp. and *Picea* spp. cover types while early seral types and alpine zones were avoided. Conversely, female bears preferred seral types and alpine, while avoiding forested cover types (Wielgus 1986). Young dense *Pinus* spp. and young open *Pinus* spp. were used by males in the late summer. Early seral types and open *Pinus* spp. cover types were important to females in late summer. No statistical differences between sexes was discovered during this season. Major food items in the late summer were *Equisetum* spp., *H. lanatum, D. caespitosa, Erythronium grandiflorum* and *Carex* spp.

Scat analyses indicated that *Hedysarum* spp. roots gained importance again in the fall. The fruit of *Shepherdia canadensis* and *Vaccinium* spp. also became prevalent in scat samples.

Male preference for young, open *Pinus* spp. types was evident in the fall. Once again, males avoided alpine and *Picea* spp. cover types. Females used young *Picea* spp. and early seral types on moderately mesic slopes. Old, dense *Picea* spp. was preferred by males in the late fall while

Table 31. Habitat preference in the Highwood Valley (Wielgus 1986).

Season	Habitat[a]	Male[b]	Female[b]
Spring:			
	Young dense Pinus	x	
	Early seral	x	x
	Alpine	x	x
	Young open Pinus		x
	Old dense Picea		x
Early Summer:			
	Old dense Pinus	x	
	Old dense Picea		
	Young open Pinus		x
	Early seral		x
	Alpine		x
Late Summer:			
	Young open Pinus	x	x
	Early seral	x	x
	Alpine		x
Fall:			
	Young open Pinus	x	x
	Early seral	x	x
	Alpine	x	x
Late Fall:			
	Old dense Pinus	x	
	Old dense Picea	x	x
	Young open Pinus		x
	Early seral		x
	Alpine		x

[a]elevation and slope between sexes often differed within the same habitat category.

[b]x = habitat category used >5% over random availability.

females used cover types within the early seral and alpine stratifications. The highest elevations in the study area were avoided, except during the late fall (Wielgus 1986).

Wielgus (1986) stated that "In general, males shifted habitat preferences over the seasons more than females." Males also tended to use the "best" food-producing habitats throughout the year. Regression models of habitat prediction varied from 71-89% depending on season. Cover type, density, slope and aspect were universally important classification variables.

Boreal Forest

Pearson (1975) and Nagy and Russell (1978) conducted research on the boreal forest grizzly bear centered in the Swan Hills area of central Alberta. The area is comprised of gently-rolling to mountainous topography bisected by bogs and muskeg. Extensive stands of *Picea* spp. and *Pinus contorta* are present. Deciduous blocks of *Populus* spp. and *Betula* spp. are also present. The climate in the Swan Hills area is continental in origin and exhibiting cold winters and wet, cool, summers. Timber harvest and petrochemical exploration and development were major land use activities in the area during the study period.

Habitat use and food habit studies were not the primary emphasis in the Swan Hills investigations. Two general patterns of habitat use, however, arose from capture and telemetry data (Nagy and Russell 1978). Grizzly bears were attracted to, and frequented, refuse dumps on the periphery of the Swan Hills townsite; this unnatural food source also lured bears into the townsite where several were destroyed. The second pattern was related to erosion control along road and pipeline right-of-ways, and at well sites. Such developments were reseeded with grasses and clovers. Scat analysis (Nagy and Russell 1978) suggested that both grizzly and black bears made significant use of these "improved habitats." Such artificial habitats may have been a factor contributing to expansion of the black bear population (Nagy and Russell 1978).

Based on a sample of 97 scats, Nagy and Russell (1978) made preliminary conclusions on the food habits of the Swan Hills grizzly bear. *Heracleum lanatum, Trifolium* spp., *Equisetum* spp. and monocots were major food items. *Vaccinium* spp. and *Viburnum* spp. were important during September through October, however, during a berry crop failure in 1977, bears apparently used *Trifolium* spp. as an alternate food. Roots and bulbs did not occur in scat samples; ground squirrels were not found in the Swan Hills.

Northern Interior

Two major grizzly bear habitat studies have been conducted in the Northern Interior: Pearson's (1975) work in the Kluane Game Sanctuary (St. Elias Mountains) and Miller et al. (1982) in the Mackenzie Mountains.

Kluane Game Sanctuary

The climate in the Kluane Game Sactuary is dry, averaging approximately 25 cm of precipitation annually, with chinook winds during winter. The St. Elias Mountains in the area reach 2400 m and drop precipitously into lower valleys. Higher elevation slopes contain alpine glaciers. Several braided-river systems are present in the Kluane area, and exhibit a riparian successional structure. Seral communities include *Hedysarum alpinum-Salix* spp. Older segments of the river system contain *Populus balsamifera* and *Picea glauca*. Prairie vegetation occurs on stream outwash areas with *H. mackenzii, Potentilla fruiticosa, Shepherdia canadensis, Salix* spp. and *Populus tremuloides*. Mid-elevation areas are dominated by stands of *P. glauca*. Communities in the subalpine zone generally lack conifer cover.

Pearson's (1975) analysis of food habits and habitat use was based on 970 observations and 128 scat samples collected from 1964 through 1969. Open sidehills near the winter den were used upon emergence. The primary food at this time was *Hedysarum alpinum* roots. Some individual bears remained in subalpine and alpine meadows during May, feeding on roots and *Salix* spp. catkins. Other green vegetation was used as snow cover retreated (Pearson 1975).

As snow cleared from valleys, bears moved to vegetated alluvial flats and continued foraging on *Hedysarum* spp. and winter-killed ungulates. Subalpine *Salix* spp. fields were used during June; 74% of telemetry fixes were from such sites. *Salix* spp. catkins occurred most frequently in scats during this month, with some use of over-wintered *Arctostaphylos uva-ursi* berries. Pearson (1975) believed that these berries were locally important.

Bears reduced their intake of catkins in June and increased consumption of grasses. Grizzly bears began using *S. canadensis* immediately upon ripening (mid to late July); the transition zone between forest and alluvial

flats was the primary foraging habitat. In only 15 of 77 observations during this time (19%) were bears not in habitats associated with *S. canadensis*. Roots, wasps, carrion and grassses were apparently consumed in July.

Bears continued to eat berries into August, and as berries dried at lower elevations, either moved into higher elevation creek bottoms to continue *S. canadensis* foraging or switched to *Hedysarum* spp. roots. By September, bears were digging roots or foraging on berries in concentrated areas of the alpine zone. Roots replaced *S. canadensis* in years of berry crop failure. Roots and late developing berries constituted the major food items in September and October, although ground squirrel (*Spermophilus undulatus*) predation also occurred. This predation was the only time when bears actively sought a protein diet (Pearson 1975).

Mackenzie Mountains

The climate in the Mackenzie Mountain region is continental in origin with an annual precipitation of 47 cm. The area studied by Miller et al. (1982) is of rugged topography with maximum elevations of 2500 m. Three habitat zones were recognized. Open stands of stunted *Picea glauca* with intervening areas of grass and shrub vegetation characterized the forest zone and *Betula glandulosa* and *Salix* spp. were dominant indicators of the subalpine shrub zone. The alpine heath-meadow zone constituted 32% of the study area. Erect shrubs in the area included *Vaccinium uliginosum, Salix* spp. and *V. vitis-idaea*.

Bears used alpine habitats in June and July (Miller et al. 1982). *H. alpinum* roots, *Equisetum* spp., grasses and sedges constituted 85% of their diet at this time. Meat comprised 3% of the diet in June and July. Subalpine areas were used in August, with *Equisetum* spp., *V. uliginosum, Shepherdia canadensis, Empetrum nigrum*, and *H. alpinum* roots being the major items consumed.

In September, bears used both subalpine and alpine areas and selected against forested areas. From September until bears entered their dens, fruit and roots were consumed. Miller et al. (1982) did not consider Mackenzie bears to be active predators on either large or small mammals.

Canadian Arctic Region

Two major brown bear investigations have been conducted in the Canadian Arctic region, 1 (Nagy et al. 1983b) in the Mackenzie River delta and Beaufort Sea area (Tuktoyaktuk Peninsula), and the other (Nagy et al. 1983a) in the Arctic Mountains of central northern Yukon.

Mackenzie River Delta-Tuktoyaktuk Peninsula

The landscape of the Delta area varies from alluvial plains near sea level, to relatively high mountains on Richards Island. The vegetation of the Mackenzie River study area has been broadly categorized as boreal forest, tundra and transitional between the 2 (Lambert 1973). Lakes and pingos are numerous. Dominant plants such as *Betula glandulosa, Empetrum nigrum, Ledum glandulosum* and *V. vitis-idaea* are dispersed on well drained slopes, high-centered polygons, in forested zones and on hummock borders (Lambert 1973). The coastal areas are vegetationally diverse; relatively well-drained sites are dominated by *B. glandulosa, Salix* spp., *Dryas integrifolia, V. uliginosum*, and *V. vitis-idaea. Sphagnum* spp. mosses occupy depressed portions of tussocks with standing water may be present throughout the summer in poorly drained sedge meadows.

The vegetation of the Caribou Hills portion of the study area varies from open forest to poorly drained sites colonized by *Picea glauca, P. mariana*, and *Betula paperifera*. The Reindeer (*Rangifer tarandus tarandus*) Grazing Herd, of some 5000 animals utilizes both the Tuktoyaktuk Peninsula and Richards Island.

Food habits from the Tuktoyaktuk Peninsula were based primarily on samples obtained from April through May, although some scats were also collected from June through September. Limited opportunity for ground work later in the year precluded further collections (Nagy et al. 1983b). Reindeer and roots of *Hedysarum alpinum* were major spring food items. Observations showed that as many as 15-20 calves were killed in 1 foray.

Monocots and *Equisetum* spp. were major diet items in the summer. These food items were abundant in the floodplains of the Delta. Reindeer, *Arctostaphylos uva-ursi*, and *V. uliginosum* were also important items during summer (Nagy et al. 1983b). Arctic ground squirrels (*Spermophilus undulatus*), believed to be a very important food source, and monocots were predominant foods during August and September. Berries were not a major food item at this time, however, sampling error or a poor berry crop may have influenced observations (Nagy et al. 1983b). Several bears appeared to focus on ground squirrel colonies in relatively high and well-drained habitats. Nagy et al. (1983b) believed that small mammals (e.g., lemmings (*Lemmus* spp.)) and muskrats (*Ondatra zibethicus*) were underrepresented in fecal samples. Muskrats were dug from "push-ups" in the spring. Observations also suggest that bears may cause isolated colony failure of nesting snow geese (*Chen caerulescens*) by foraging on eggs.

Arctic Mountains, Yukon Territory

Portions of the Arctic Mountains study area (Nagy et al. 1983a) are of rugged mountain topography (1500 m), and include the Arctic Plateau between 2 mountain ranges and a portion of the coastal plain. The study area occurs within the zone of continuous permafrost. The coastal plain is generally devoid of trees, however, *Picea glauca, P. mariana* and *Betula balsamifera* occupy protected valleys. These coastal plain lowlands are extremely moist during the summer and support *Eriophorum angustifolium* and sedge meadows. *Salix* spp. thickets are present along river, stream and lake margins, with higher sites generally dominated by *Vaccinium* spp., *B. balsamifera, Empetrum nigrum* and *Oxytropis* spp.

Grizzly bear food habits in the Arctic Mountains were similar to those of Tuktoyaktuk Peninsula (Nagy et al. 1983a). Bears fed primarily on *E. nigrum* and *Hedysarum alpinum* roots in late May. Grasses were the major diet item in June and July. Roots, *E. nigrum* fruit, and Arctic ground squirrels were also consumed at this time. *Shepherdia canadensis* was occasionally eaten. There was an apparent segregation of habitat use by various age and sex classes. Females with young were most often found at lower elevations relative to other classes (Nagy et al. 1983a).

Scavenging or predation on the barren ground caribou (*Rangifer tarandus groenlandicus*) was infrequent (Nagy et al. 1983a), which was surprising because the Porcupine caribou herd migrates through the study area. Two instances of bears feeding on dead beluga whales (*Delphinapterus leucus*) were recorded.

MANAGEMENT TECHNIQUES AND STRATEGIES

TIMBER

While many studies document reduced grizzly bear use of logged areas (Perensovich 1966, Russell 1974, Lyon and Basile 1980, Mace and Jonkel 1980b, Zager et al. 1983), others report no evidence that logging impacts grizzlies (Meehan 1974, Zager 1980a). Aerial surveys over a 6 year period in the northwestern U.S. and southern Canada showed no changes in grizzly bear populations and little reduction in the number of cubs produced per year as logging pressure increased, however, bear home ranges were substantially reduced during this period (Mace and Jonkel 1980b). These conflicting results suggest that while bear numbers may not be immediately affected by logging activites, their behavior is almost certainly modified.

Timber Harvest

Alterations in timber cover can affect the quality of grizzly bear food and cover (Blanchard 1983, USFS 1985a) causing bears to change their use of an area. Grizzly habitat can be affected by timber harvesting in 3 ways:

- vegetation arrangement and abundance can be changed affecting the quality and quantity of food and cover (Ruediger and Mealey 1978, Sigman 1985, USFS 1985i).
- human use patterns may be altered (Ruediger and Mealey 1978, USFS 1985i). Logging practices make grizzly habibat much more accessible to man (Craighead 1980).
- existing water regimes may be indirectly impacted; surface and/or subsurface water movement and/or distribution may be changed (Archibald 1983, Ruediger and Mealey 1978). Logging in carex meadows substantially alters water levels by increasing runoff and blockage of water by slash (Russell 1974).

Nevertheless, changes in vegetation can be predicted and timber management coordinated to benefit grizzlies and their habitat (Ruediger and Mealey 1978, Servheen et al. 1981, USFS 1985a); vegetation changes can, in some cases, actually enhance grizzly bear habitat (USFS 1983b, 1985aci, 1986, Holland 1986) and the impacts of human disturbance can be mitigated by temporal constraints, shortened contract periods, providing displacement areas and managing access (USFS 1985a). The U.S. Forest Service and National Park Services presently evaluate all logging activities for their potential impact on grizzly bears (Mealey 1979, 1986, USFS 1983b, 1985ab) and permit no activities which adversely affect grizzlies (Mealey 1979, 1986, USFS 1983b). Although management strategies differ between Management Situations 1 and 2 (Contreras 1983, USFS 1983b, 1985b), emphasis will be on the conservation of grizzly habitat and foods (Ruediger and Mealey 1978, Contreras 1983). If funds are available, timber sale project plans should include proposals for grizzly bear habitat improvement (USFS 1985c). Timber sale receipts (Knudsen-Vandenberg Act funds) can, and should, be used for this purpose (Mealey 1979, 1986, USFS 1983b, 1985bci, Garcia 1986, Holland 1986).

Management of habitat for grizzly use should be designed to provide food (fruits, succulent herbs, grasses and sedges), cover (thermal and hiding) and living space (home range) (Ruediger and Mealey 1978, Contreras 1983).

Timber harvesting practices which can be manipulated to provide the above are timing, location and type of cut (size, shape, species); use of buffer zones or leave strips and post-harvest treatments (slash disposal, revegetation). These are discussesd in more detail in the following sections.

Timing of Cut

In as much as logging disturbances are cumulative, timber sales must not be planned as isolated events; past and future activities must be evaluated (Jonkel et al. 1979) and harvest planning should consider long term consequences (Hillis 1986). Cumulative effects analysis procedures are useful for determining the impacts of proposed logging activities on bear populations (USFS 1985a). Specific suggestions for scheduling harvesting activities follow:

- logging should take place at a time of little or no biological importance to bears (Jonkel et al. 1978, Ruediger and Mealey 1978, Mealey 1979, 1986, Zager 1980a, Jonkel 1982a, USFS 1983a, Garcia 1986).
- if possible, logging should take place in winter to minimize soil disturbance and compaction (Meyers 1978, Orme and Williams 1986). If winter logging is infeasible, operations should take place primarily in summer (Mealey 1979, 1986).
- logging should be concentrated into the shortest time frame possible (USFS 1985ci, Orme and Williams 1986).
- operations should not take place simultaneously on adjacent areas (same or next drainage) (Jonkel et al. 1979, Servheen et al. 1981, Jonkel 1982a, Perensovich 1984, USFS 1985i). Erickson (1975) suggests a series of belt cuts at spaced periods to allow regeneration between harvest periods. Large scale sales should not be planned on adjacent lands (same or next drainage) within short (10-15 years) time intervals (Jonkel 1982a). Coordination between adjacent landowners may be required (Jonkel 1982a).
- timber harvest schedules should be coordinated with other land activities to reduce simultaneous impacts (Mace and Jonkel 1980a).
- harvesting should be scheduled to optimize vegetational responses beneficial to grizzlies (Contreras 1983, Garcia 1986).

Location of Cuts

Cuts should not be located near grizzly bear biological centers (Meyers 1978). Specific suggestions are:

- cuts should be limited to areas where the slope is less than 35% and tractor yarding is possible (USFS 1985c).

- adequate timber cover must be maintained near foraging areas and den sites (Lyon and Basile 1980).
- cuts should not take place near travel corridors, feedings sites, or denning areas (Zager 1980, Jonkel 1982a, USFS 1985a).
- areas adjacent to core grizzly management areas should not be cut as this may draw bears away from the core and into closer contact with man (Erickson 1977, 1978).
- cuts should not take place in hydric stream bottoms, wet meadows, marshes or bogs where soil disturbance may be high.

Logging in or Near Riparian Areas

Riparian zones are heavily used by grizzlies for feeding and as travel corridors. While stream bottoms can be opened up to produce bear foods such as wet site forbs and graminoids (Bratkovich 1986, Hillis 1986), special consideratiaons must be taken when logging in, or near, these areas. Specifically:

- soil disturbance should be minimized particularly on mesic or hydric sites (USFS 1985i).
- hydrophilic vegetation should not be altered (USFS 1985i).
- broadcast burning or hand piling and spot burning are recommended as site preparation methods (USFS 1985i).
- in some areas, strips of uncut timber should be left along rivers to protect salmon streams (Archibald 1983).
- cover should be maintained at 4-6 sight distances around riparian zones (USFS 1985i).
- slash should be piled to reduce alder regeneration and allow the site to be occupied by forbs and grasses (Hillis 1986).

Type of Cut

Timber stands can be managed for size, shape, interspersion, degree of crown closure, age structure and edge contrast (Zager 1980a, Contreras 1983, Zager et al. 1983) to provide for bear needs. Size and shape are important as they relate to distance to escape cover. Size and spacing considerations are:

- boundaries of all cuts should be irregular (Zager 1980, Jonkel 1978).
- cuts should be shaped so that cover is within 46 m (150 ft) of all points in the opening (USFS 1985i).
- cuts should have a width of 91 m (300 ft), but be no wider than 183 m (600 ft) (USFS 1985ci).

Silvicultural methods commonly used in timber management are clearcuts, seed tree, shelterwood and single- or group-tree selection (Contreras 1983). These methods can be used to enhance both grizzly food and cover (Tables 32a and b) and are discussed in more detail below.

Clearcuts

Clearcuts ranked second in importance among logged sites used by grizzly bears in a study by Mealey et al. (1976). Their size, shape and arrangement should, to the degree possible, resemble natural openings to attract bears (Zager 1983, USFS 1985i). Specific recommendations concerning clearcuts are:

- plan smaller cut areas (<50 acres) leaving cover nearby (Zager 1983, Horejsi 1986a).
- large clearcuts (>10 acres) may be planned incorporating 1 or more leave patches of at least 5 acres, well developed understories and no visible access points (Mealey et al. 1977, Mealey 1979, 1986, USFS 1983b, Zager 1983).
- if clearcuts exceed 40 acres, cutting configuration must allow grizzly access to cover within 91 m (300 ft) for over 80% of the unit (Orme and Williams 1986) with openings of 100 m (328 ft) in width (Meyers 1978, Orme and Williams 1986).
- edge can be maximized (Blancharad 1983) and sight distance reduced by creating an undulating edge (USFS 1985i, Orme and Williams 1986).
- minimum soil scarification should occur (Mealey et al. 1977, Mealey 1979, 1986, USFS 1983a) in habitat types where soil disturbance hinders regeneration (20% or less in strip configuration) and broadcast burns should be used (Mealey et al. 1977, Mealey 1979, 1986 USFS 1983b).
- cuts should be planned so that adjacent harvested units qualify as summer hiding cover (USFS 1985c). This may require 25-30 years in moist forests and much longer on more xeric sites (Zager 1983).
- cover strips should be left around clearcuts and other open grizzly feeding areas (Orme and Williams 1986, Jonkel 1982a). Timbered strips between cuts should be at least 100 m (328 ft) wide between clearings (Meyers 1978, Blanchard 1983).
- clearcuts should be screened from roads by leaving a strip of trees to promote bear use of early vegetative stages and to minimize poaching from access roads (Servheen et al. 1981).
- livestock should be excluded from clearcuts as they graze on forbs valuable to grizzly bears. Livestock exclusion will also reduce bear/human conflicts (Meyer 1978, Contreras 1983).
- northern slopes are the most productive clearcut sites (Jonkel et al. 1982) probably because mesic conditions accelerated recovery of shrub (Mealey et al. 1976).
- clearcut areas adjoining meadows only when 20% or less of the periphery of the meadow is affected (USFS 1985i).

Clearcuts can benefit grizzlies in vegetation types such as:

- shrubfield sites — douglas fir/blue huckleberry, subalpine fir/beargrass/blue huckleberry, grand fir/beargrass (Hillis 1986).
- lodgepole pine stands (followed by extensive soil scarification) (Contreras 1983, Orme and Williams 1986).

Table 32a. Habitat and grizzly bear considerations in forested grizzly habitat components in northwestern Montana and northern Idaho, 1977 (adapted from Ruediger and Mealey 1978).

Forest Habitat Type Component	Timber Productivity	Timber Suitability	Grizzly Bear Food Productivity	Grizzly Bear Use Period	Important Food Items	Important Features	Acceptable Silvicultural Methods	Suggested Site Preparation
PIAL/ABLA								
Pinus albicaulis Abies lasiocarpa	L	L	M	Summer, Fall	Pinus albicaulis, Lomatium spp. Erythronium qrandiflorium, Claytonia lanceolata	ridgetop	none	none
ABLA/CACA								
Abies lasiocarpa Calamagrostis canadensis	M	L	H	Spring, Summer, Fall	Heracleum lanatum, Angelica arguta, Osmorhiza occidentalis, Mesic grasses	stream-bottoms, wet meadows	salvage or selection	lop, scatter
ABLA/LUHI/MEFE								
Abies lasiocarpa Luzula hitchcockii h.t. Menziesia ferruginea phase	L	L	H	Summer, Fall	Heracleum lanatum, Angelica arguta, Osmoryhiza occidentalis, Mesic grasses, Vaccinium globulare	gently sloping topography, upper basin mesic sites	none	none
ABLA/LUHI/VASC								
Abies lasiocarpa L. hitchockii, h.t. Vaccinlum scoparium	L	L	M	Late Summer, Fall	Claytonia lanceolata, Vaccinium globulare, Vaccinium scoparium, Pinus albicaulis albicaulis	subalpine burns	none	none
ABLA/XETE/VASC								
Abies lasiocorpa/ Xerophyllum tenax h.t. Vaccimium scoporium	L	L	M	Late Summer, Fall	Vaccinium globulare, Vaccinium scoparium	burns	salvage, selection	broadcast burn, lop and scatter, or trample
ABLA/XETE/VAGL								
Abies lasiocorpa/ Xerophyllum tenax h.t. Vaccinium globulare	M	L M	H	Mid-Summer, Early Fall	Vaccinium globulare, Vaccinium scoparium	burns	salvage, group selection or clearcut	broadcast burn, strip scarify if necessary, but don't exceed 35% of site
ABLA/LIBO/XETE								
Abies lasiocorpa/ Linnaea borealis h.t. Xerophyllum tenax	M	L M	H	Mid-Summer, Fall	Vaccinium globulare, Shepherdlia canadensis, Arctostaphylos uva-ursi	seral stages are the most productive food sites	clearcut group selection, shelterwood, selection thinning	broadcast burn, strip scarify if necessary, but don't exceed 35% of site
ABLA/CLUN/MEFE								
Abies lasiocarpa/ Clintonia uniflora h.t. Menziesa ferruginea	H	L M	H[a] L[b]	Late Summer, Early Fall	Vaccinium globulare, Sorbus scopulina	early successional stage openings without over- scarifi-cation	clearcut, group selection, shelterwood, selection thinning	broadcast burn, strip scarify if necessary, but don't exceed 35% of site
ABLA/CLUN/XETE								
Abies lasiocarpa/ Clintonia uniflora h.t. Xerophyllum tenax	M	L M	M	Mid-Summer, Early Fall	Vaccinium globulare, Sorbus scopulina, Shepherdia canadensis	burns	clearcut, group selection, shelterwood, selection thinning	broadcast burn, strip scarify if necessary, but don't exceed 35% of site
ABLA/CLUN/CLUN								
Abies lasiocarpa/ Clintonia uniflora h.t. Clintonia uniflora phase	H	H	M	Spring, Summer, Fall	Osmorhiza occidentalis, Erythronium grondiflorium, Heracleum lanatum, Angelica arguta, Mesic grasses	mesic sites, stream-bottoms	clearcut, group selection, shelterwood, selection thinning	broadcast burn, strip scarify if necessary, but don't exceed 35% of site

Table 32a. (Continued)

Forest Habitat Type Component	Timber Product-ivity	Timber Suit-ability	Grizzly Bear Food Product-ivity	Grizzly Bear Use Period	Important Food Items	Important Features	Acceptable Silvicultural Methods	Suggested Site Preparation
ABLA/CLUN/ARNU								
Abies lasiocarpa/ Clintonia uniflora h.t. Aralia nudicaulis phase	H	H	M	Spring, Summer, Fall	Vaccinium globulare, Mesic grasses, and forbs, Cornus stolonifera	mesic sites, stream-bottoms	salvage, group selection	broadcast burn, do not scarify
ABLA/MEFE								
Abies lasiocarpa/ Mensiesia ferruginea	M	L	L	Negligible	Few	security habitat and mesic sites	not important consideration in grizzly management	
PSME/VAGL								
Pseudotsuga mensiesii, Vaccinium globulare	M	M	M	Fall	Vaccinium globulare	burns, good berry production	clearcut, group selection, shelterwood, salvage	broadcast or understory burn, strip scarify if necessary
PSME/FIED PSME/CARLI								
Pseudotsuga mensiesii Festuca idahoensis Calamagrotis rubescens	L	L	M	Early Spring	Grass, Arctostaphylos uva ursi	sidehill parks	selection, group selection, salvage	lop and scatter or pile and burn
PSME/AGSP								
Pseudotsuga menziesii Agropyron spicatum	L	L	M	Spring	Grass, Arctostaphylos uva ursi	sidehill parks	selection, salvage	lop and scatter or trample. Do not burn.
PICEA/CLUN PICEA/EQAR								
Picea/Clintonia uniflora Picea/Equisetum arvense	H-M	H	M	Spring, Summer, Fall	Sorbus scopulina, Cornus stolonifera, Mesic grasses and forbs	stream-bottoms	clearcut, group selection, shelterwood	prescribe burn

[a]L = Low, M = Medium, H = High
[b]Early successional stages
[c]Mid-Late successional stages

Table 32b. Habitat and grizzly bear considerations in nonforested habitat components in northwestern Montana and Northern Idaho, 1977 (adapted from Ruediger and Mealey 1978).

Habitat Type Component	Timber Product-ivity	Timber Suit-ability	Grizzly Bear Food Product-ivity	Grizzly Bear Use Period	Important Food Items	Important Features	Acceptable Silvicultural Methods	Suggested Site Preparation
Avalanche chutes	L	L	H	Spring, Early Summer, Fall	Mesic grasses and forbs	south slope-spring, north slope-summer	none	none
Burns	M-L	variable	H	Mid-Summer, Late Fall	Fruiting shrubs	important on south slopes	salvage, high risk	burning
Wet meadows	L	L	H	Spring	Mesic grasses, sedges and forbs			
Sidehill parks	L	L	M	Spring	Grass			
Low gradient streambottom	H	variable	H	Spring, Summer, Fall	Mesic grasses and forbs, fruiting shrubs			

[a]L = Low, M = Medium, H = High
[b]Early successional stages
[c]Mid-Late successional stages

- mountain spruce/fir habitats (Contreras 1983).
- AF/CLUN/MEFE habitat types (with no slash piling or mechanical scarification (Mealey et al. 1977).

Clearcuts will probably not produce beneficial grizzly habitat when combined with soil scarification and slash piling (Jonkel 1982). Habitat types which do not benefit grizzlies following clearcutting are:

- ponderosa and lodgepole pine where high soil temperatures inhibit regeneration (Zager 1983).
- riparian areas such as stream bottoms, wet meadows, marshes and bogs (Russell 1974, USFS 1983b, Bratkovich 1986).

The disadvantages of clearcuts are that substrate debris may impede bear movements, thermal cover is less available than in uncut, or selecive cut areas, and the lack of canopy cover may shorten the berry season (Smith 1978).

Selection Cuts

Selection cuts ranked highest in grizzly food production and maintenance of adequate cover when the forest canopy was opened by selective tree removal for areas in the northwestern United States and southern Canada (Mealey et al. 1976). Zager (1983) notes that selectively logged sites may be the most productive bear habitat in the northwest. In general, important herbs and fruit bearing shrubs are benefitted by selection cuts (Mealey et al. 1977, Mealey 1979, 1986, Zager 1983, USFS 1983b, 1985i, Orme and Williams 1986).

Specific recommendations for selection cuts are:

- remove 20% of the stands basal area (USFS 1985i).
- do not harvest adjacent stands before 10-15 years after a selective cut (USFS 1985i).

Habitat types where selective cuts produce valuable grizzly habitat are:

- spruce/fir types (Zager 1983, Contreras 1983).
- ALBA/CLUN/MEFE (without site preparation) (Ruediger and Mealey 1978).
- subalpine fir and cedar/hemlock (no slash piling and no mechanical scarification) (USFS 1983b).
- ponderosa and lodgepole pine sites (remaining trees moderate soil temperature and allow understory recovery) (Zager 1983).
- in douglas fir/ponderosa pine and grand fir forests.
- in areas where heavy concentrations of pine beetle damaged trees constitute a fire threat (Orme and Williams 1986).

Selection cuts may not be appropriate in lodgepole pine stands when quick regeneration is needed (Orme and Williams 1986) or near clearcuts where adequate cover for travel, escape, and rest may not be available (Meyer 1978).

Seed-tree cuts provide adequate food and cover in shrubfield sites. While Mealey et al. (1976) found that shelterwood cuts ranked lowest in food and cover production, this technique may be beneficial if used in douglas fir habitat types (Contreras 1983).

Age Structure

Long-term grizzly habitat management should maximize vegetation diversity, approximate natural conditions and include all successional stages (Mattson 1983, USFS 1983b, Zager 1983). Specifically, managers should work toward a minimum percentage (10%) of the following size/age classes (USFS 1985bc):

- old growth.
- mature.
- young (or immature).
- pole/sapling.
- shrub/seedling.
- grass/forbs.

Seral Stages

Diversity of seral stages is generally the rule when managing forested lands for wildlife, however, some seral stages are of more value as grizzly habitat components than others. Specifically:

- early successional stages are valuable in producing grizzly foods (grasses, herbs, and fruits) (Erickson 1976, 1978, Servheen et al. 1981).
- mid-successional stages and pole-size stands of timber are of less value, particularly if they are dense, single species, even-aged stands (Erickson 1976, 1978).
- mature stands are less effective as habitat barriers (Erickson 1978).
- some over-mature and mixed aged stands should be retained for thermal cover and denning habitat (Mattson 1983).

Uneven-aged management should be used as it reduces disturbance and produces valuable food and cover species after each stand entry (Jonkel 1982a, Contreras 1983, Zager and Jonkel 1983, USFS 1985c).

Species to be Cut

Logging can also be used to favor plant/timber species important to grizzlies for food and cover (Contreras 1983). Recommendations for management of timber and habitat types that benefit bears are:

- clearcut sitka spruce and western hemlock; bears prefer 15-25 year old sites (Montana) (Zager 1983).
- maintain mid-volume hemlock stands on slopes >20 degrees at elevations of >300 m (984 ft) for den habitat (Alaska) (Schoen et al. in press).
- maintain pacific silver fir and western hemlock stands for thermal cover (British Columbia) (Smith 1978).
- maintain *Oplopanax horridus, Rubus spectabilis* and *Athyrium filix-femina* to provide food and security cover (British Columbia) (Smith 1978).
- maintain lodgepole pine stands (YGBE) (Orme and Williams 1986) and thin to allow browse and grass growth (NCDE) (Holland 1986).

- maintain subalpine fir/beargrass/huckleberry which provide good grizzly food (NCDE, YGBE) (Mealey 1979, 1986, Bratkovich 1986).
- maintain subalpine fir/beadlily (Montana) (Zager et al. 1983).
- maintain subalpine fir/menziesia (Montana) (Zager et al. 1983).
- maintain western hemlock/beadlily/beadlily type habitats which provide good foods (Montana) (Bratkovich 1986).
- maintain subalpine fir/bluejoint habitat (YGBE) (Mealey 1979, 1986).
- maintain or plant aspen stands for quick growing cover around wet sites (NCDE, YGBE) (Contreras 1983, Holland 1986).
- maintain or reestablish whitebark pine in late successional, climax stands for cone production and as den habitat (NCDE, YGBE) (Mealey 1979, 1986, USFS 1985bc, Eggers 1986, Mattson and Reinhart 1986):
    - — do not cut unless it is expected to die before the next scheduled cutting (Mealey 1979, 1986, Contreras 1983, USFS 1985b).
    - — expand stands above 2500 m (8500 ft) (USFS 1985h).
    - — maintain pure stands which are not favorable to squirrels and hence are more valuable to bears (Mattson and Reinhart 1986).
    - — provide a variety of age classes over time (USFS 1985h).
- maintain engelmann spruce stands above 2440 m (8000 ft) (YGBE) (USFS 1985h).
- maintain late successional stands of ALBA/VASC-PIAL phase and ALBA/CACA habitat types as they are prime late summer and fall habitats (YGBE) (Mattson and Reinhart 1986).
- maintain recently logged shrub communities as they provide hiding cover (British Columbia) (Smith 1978).

Use of Buffer Zones, Leave Strips

Buffer zones can be used to limit human access into grizzly use areas and provide effective movement barriers for grizzlies (Erickson 1975, 1977). Timber management in buffer zones should make the habitat less attractive to grizzly bears (i.e., create expansive stands with little or no herbaceous or shrubby vegetation or 'dog hair' or pole-aged stands managed on a short- to medium rotation) (Erickson 1975, 1978).

Strict fire control and control of insect infestation are important to maintaining continuous forest buffer zones (Erickson 1975). Several recommendations follow:

- leave buffers of at least 90 m wide around existing bear trails (Lloyd and Fleck 1977).
- leave buffers of at least 110 m wide next to lowlands, mountain meadows and snowslides (Lloyd and Fleck 1977).
- provide a buffer of 1-2 miles between all areas of prime grizzly habitat and human use areas (Erickson 1975, 1978).
- avoid timber cuts in managed buffer zones (Erickson 1978).
- timber harvesting in buffer zones should be done in a series of narrow belts paralleling prime grizzly habitat. Allow reforestation of 1 belt before harvesting the next (Erickson 1976, 1978).
- discourage intermixing cuts across or through buffer zones which break the continuity of the forest stand (Erickson 1975, 1978).

Leave Strips

Leave strips can function as effective buffer zones and should be maximized in harvest areas. Their size and location should determine the size and shape of any cuts (Jonkel et al. 1978). They are important as travel corridors, resting cover (Jonkel et al. 1978) and visual screens which reduce intraspecific stress (Archibald 1983). They should be located (Jonkel et al. 1978):

- along salmon rivers to protect anadromous fish which constitute a large part of grizzly bear diets in some areas (Archibald 1983).
- to encompass open feeding sites (avalanche chutes, meadows, shrubfields, sidehill parks, creek bottoms) (Mealey et al. 1977, Jonkel 1982a).
- to allow continuous travel cover in and between drainages (Jonkel et al. 1978, Zager 1980a, Servheen et al. 1981, USFS 1985a).
- along road edges (Jonkel 1978, Jonkel et al. 1978).
- in mature conifer stands with moderately dense understory shrubs (Jonkel et al. 1978).
- so that their shape and size act to reduce the possibility of windthrow (Jonkel et al. 1978).
- so that cutting units are a maximum of 50 acres and have irregular boundaries (Jonkel et al. 1978).

Security Areas

Escape and resting cover can be maintained by coordinating cuts between adjacent landowners, timber sale layout and road management (Zager 1980a, Jonkel 1982a, USFS 1985a). Security areas should:

- be at least 5000 acres adjacent to timber sale areas (USFS 1982).
- be maintained around 75% of the perimeter of any opening (USFS 1985ac) and hiding cover should have a minimum width of 3 sight distances.
- be maintained to provide a minimum of 40% cover (20% summer hiding and 20% thermal cover) (USFS 1982, 1985ci).
- be maintained around wet areas such as streams, meadows, marshes, and around ridgetops, snow chutes, shrub fields, sidehill parks and slabrock areas (Servheen et al. 1981).
- provide cover to hide 90% of a grizzly bear at 61 m (200 ft) (Contreras 1983, USFS 1985i).

- be a minimum of 4 sight distances across (183-244 m: 600-800 ft) and on riparian sites 6-8 sight distances, (274-488 m: 900-1600 ft) (USFS 1985i).
- provide a thermal cover of conifers 12 m (40 ft) wide with a 70% canopy cover (USFS 1985i).
- provide thermal canopy cover of 50% on north facing slopes higher than 2440 m (8000 ft) (USFS 1985i).
- provide a minimum cover of 50-300 stems at least 7 feet tall/acre depending on other site characteristics such as topography, percent brush and percent stocking (USFS 1982i).

Post Harvest Treatment

Site treatment following logging can greatly enhance grizzly bear habitat by improving food species and other habitat components (Jonkel 1980a, Archibald 1983). Possible site preparation methods include soil scarification, slash disposal and prescribed burning. These can be followed by herbicide treatment and artificial regeneration to produce stands compatible with grizzly management objectives.

Soil Scarification

Although soil scarification is a commonly used method of preparing logged areas for timber regeneration, its value in enhancing grizzly food plants is questionable. In general, scarification should be minimized (Jonkel 1980a, Zager 1980a, Jonkel 1982a) because studies indicate that:

- while scarification increased regeneration of bear foods such as grasses, sedges, and clover, it decreased shrubs which provided food and cover (Zager and Jonkel 1983, Bratkovich 1986).
- scarification of sites retarded establishment of perennial shrubs and herbs (Mealey et al. 1976).
- recovery of vegetation was slower (greater than 25 years) on scarified sites (Zager 1983).
- scarification may destroy rhizomatous plants (e.g., *vaccinium* spp.) and the roots of other species (e.g., buffalo berry) (Jonkel et al. 1978, Zager et al. 1983).
- scarification on drier rounded side slopes may prevent shrub response (Bratkovich 1986).
- the percent cover of globe huckleberry, red-osier dogwood and service berry was lower on scarified (Zager et al. 1983).

Where soil scarification is required for adequate regeneration, it should be restricted to highly disturbed sites or planned in a strip configuration through clearcuts. Soil scarification and compaction can also be an artifact of timber practices which can be ameliorated by:

- carefully supervising machine operators (Jonkel 1978).
- using high-lead cable yarding systems (Zager et al. 1983).
- using single-end log suspension (Jonkel 1978, Mealey 1979, 1986).
- using horse logging and skidding (Jonkel 1982a).

Slash Disposal

Slash disposal can be accomplished mechanically by dozer piling, through the use of prescribed burns or by both methods. Slash not piled may physically hinder bear use of an area (Russell 1974, Smith 1978) or may limit establishment of bear foods (Bratkovich 1986). However, the merits of dozer piling are questionable for the following reasons (Table 33).

- increased soil scarification and compaction occur (Jonkel et al. 1978).
- if areas are to be burned later, unequal burn intensities and extreme temperatures may result in regeneration problems (Jonkel et al. 1978, Zager et al. 1983).
- o key shrubs may decline in areas where slash was piled before burning (Zager et al. 1983).
- dozer piling does not appear to aid in the establishment of desirable forbs and graminoids (Bratkovich 1986).

If piling is necessary:

- operators should use a brush blade to minimize disturbance of rhizomatic vegetation (Lyon and Basile 1980).
- use of light, rubber tired equipment will minimize soil compaction (Jonkel 1980a, Zager 1980a, Jonkel 1982a).
- piling should be limited to less than 20% on sites containing globe huckleberry (USFS 1985i).
- dozers should avoid areas where reasonable ground cover remains (Jonkel et al. 1978).
- dozer piles should be small and scattered throughout the cutting unit (Jonkel et al. 1978).
- hand piling may be feasible. Logs should be evenly distributed among size and decomposition classes and can be crisscrossed. Such piles should be distributed over 10-20% of the area at a fuel loading rate of 25-50 tons/acre (USFS 1982).

Burning

Slash can be broadcast burned or piled and burned. Because piling slash has several negative effects on regeneration (see previous section), broadcast burns are often recommended (Jonkel et al. 1978, Lyon and Basile 1980, Zager 1980a, Zager et al. 1983, USFS 1985) for the following reasons (Jonkel 1978, Jonkel et al. 1978, Zager 1980a, Servheen et al. 1981, Jonkel 1982a, Bratkovich 1986, Holland 1986):

- foraging opportunities for grizzlies are enhanced as broadcast burns encourage the growth of fruiting shrubs (Lyon and Basile 1980, Bratkovich 1986).
- slash accumulations pose fire hazards (Meyer 1978, Zager et al. 1983).
- slash accumulation may inhibit regeneration (Zager et al 1983).

Table 33. Shrub revegetation response to 3 kinds of disturbance in 4 habitat types used by grizzly bears in northwestern Montana (from Zager et al. 1983).

		Change in % canopy coverage		
Habitat type	Shrub species	Wildfire	Clearcuts, no piled slash	Clearcuts with piled slash
Subalpine fir/beadlily	Amelanchier alnifolia	+0.2[a]	+6.8	-0.9
	Cornus stolonifera	+14.5	-0.5	-0.5
	Shepherdia canadensis	0	-0.5	-0.1
	Sorbus spp.	+0.4	-3.1	-4.1
	Vaccinium globulare	-8.3	-4.1	-16.3
	V. scoparium	+2.0	-3.9	-2.9
Subalpine fir/menziesia	A. alnifolia	0	0	+3.0
	S. canadensis	-3.0	-3.0	-2.5
	Sorbus spp.	+2.9	+8.1	+0.2
	V. globulare	+4.5	+4.9	-10.3
	V. scoparium	+11.6	-2.4	-1.9
Subalpine fir/beargrass	A. alnifolia	+7.9		
	S. canadensis	+0.5		
	Sorbus spp.	+0.8		
	V. globulare	+11.8		
	V. scoparium	+4.3		
Subalpine fir/wood rush	Sorbus. spp.	-0.9	-1.3	
	V. globulare	-0.3	-5.3	
	V. scoparium	+3.4	-5.8	

[a]Increase (+) or (-) in % canopy cover on plots when compared with that on plots in undisturbed, old-growth stands in the same habitat.

Regeneration

Sites can be regenerated either naturally (by using natural silvicultural methods such as seedtree, selection cuts, etc.) or artificially either by seeding or planting (Eggers 1986). Within 5 years of logging, production of bear foods should increase (Meehan 1974). Moist sitka spruce, cedar/hemlock and spruce/fir sites may produce adequate food and cover within 10 years of harvest while recovery on drier sites (douglas fir and ponderosa pine) may be much slower (Zager 1983). Recovery will also be retarded where soil scarification has occurred and may take up to 25 years on heavily scarified soils (Zager 1983). To enhance natural regeneration plans should incorporate seedtree, shelterwood or other selection regeneration methods; coordinate site preparation activities with cone crops (Eggers 1986) and increase cone production (Eggerrs 1986).

Where natural regeneration is not adequate, or where it is desirable to alter dominant species, artificial means can be used to reforest a logged area (Garcia 1986). Areas can be revegetated with grasses, legumes and shrubs (USFS 1985a).

Clover can be seeded to reclaim roads and landings (Servheen et al. 1981, Holland 1986) and riparian areas can be revegetated to improve or maintain water tables, resulting in stream stabilization and/or water spreading (USFS 1983b).

Herbicide treatments to control shrubs are available, but not advised as they eliminate berry plants (Archibald 1983, Zager 1983).

After logging operations have ceased, roads should be closed and revegetated (see *Roads* in this Compendium). Bear populations should be monitored to determine if any logging has impacted populations (Perensovich 1984).

Human Impacts

Changes in human use of a logged area may be even more detrimental to grizzly bears than actual alterations in vegetation. Logging operations greatly increase access to, and therfore human use of, an area which may lead to increased grizzly/human interactions (Chadwick 1974, Meehan 1974, Russell 1974, Erickson 1976, Craighead 1980, Archibald 1983, Horejsi 1986). Activity in grizzly habitat can be changed by modifying road management plans and carefully following guidelines for camps. Suggestions are:

- modify road management (Erickson 1978, Jonkel et al. 1978, Jonkel 1982a, USFS 1983b, 1985i, Zager 1983, Horejsi 1986a) (see *Roads* in this Compendium).
- manage work crew camps to minimize garbage and conflicts within prime grizzly habitat (Perensovich 1966, Jonkel et al. 1978, Mealey 1979, 1986, Craighead 1980, USFS 1983b, 1985i, Perensovich 1984) (see *Outfitters* in this Compendium).
- inform timber managers and work crews of the possible risks associated with working in grizzly habitat (Perensovich 1966, Jonkel et al. 1978, Mealey 1979, 1986).
- include information on bear use and problems in each timber sale inspection report.

ROADS

The USFS (1982) indicated that "the initiation of a viable road management plan is probably the most important factor influencing the long-term impacts on grizzlies in habitat influenced by timber harvesting." Elgmork (1978a) and Jonkel (1982a) report grizzly avoidance of roads and areas with high road densities. However, Almack (1986) found no significant difference between distance to nearest road measurements from bear locations and random points, while Erickson (1977) even suggests that grizzlies may use roads preferentially as travel corridors. Even if roads do not directly impact grizzly habitat, they allow easy human access to grizzly use areas (or adjacent areas) and provide travel corridors for bears into human developments and areas where bears will not be tolerated (Erickson 1977).

For all projects, existing and proposed roads should be evaluated by a biological review process to determine their potential for affecting grizzly bear habitat (USFS 1985a). In general, the road system should be limited to what is necessary to enhance and protect grizzly habitat (Meyer 1978).

Road management criteria should:

- minimize the number of miles of road needed to achieve each objective. Ruediger and Mealey (1978) suggest <= 1 mile/square mile.
- maximize use of local roads, minimize use of arterials and collectors (USFS 1985g).

Road density can be managed effectively in three ways: careful planning of new roads and restrictions or closures of existing roads. These are discussed in detail below.

Building New Roads

Jonkel (1982a) suggests that new roads have the greatest impact on grizzlies because bears eventually avoid the surrounding area and a block of habitat is lost. All new roads should be constructed to facilitate their eventual closure and obliteration. Several suggestions for minimizing the impacts of new road construction follow:

- build roads to minimum specifications to discourage high use but maintain safety and environmental conditions (Zager 1980a, Jonkel 1982a, Contreras 1983, Zager and Jonkel 1983, Aune and Stivers 1985).
- minimize clearing widths, low cuts and fills; maximize diversity in horizontal and vertical alignment (USFS 1985abc):
  - — keep road clearance to what is necessary for construction (Contreras 1983, USFS 1985a).
  - — provide cover as close as possible on both road edges (Jonkel et al. 1981).
  - — delete 3 ft paved shoulders (Jonkel et al. 1981).
  - — delete gravelled side slopes and ditches (Jonkel et al. 1981).
- store top soil for later use in restorataion. All unusable material should be moved from the area and disposed of properly (Contreras 1983).
- locate roads to avoid moist areas, ridgetops, saddles or creekbottoms as grizzlies use such areas for feeding and as travel corridors (Meyer 1978, Zager 1980a, Jonkel 1982a, Zager and Jonkel 1983).
- allow a buffer of 100 m between important grizzly use areas and new roads to provide adequate cover (Zager and Jonkel 1983, Aune and Stivers 1985). Wider buffer strips may ie necessary in open habitat or on steep slopes.
- reduce sight distances using "dog legs" or "crooks" (Jonkel 1982a, Zager and Jonkel 1983, Brannon 1984, Aune and Stivers 1985).
- avoid constructing "loop" roads as these are more heavily used by people (Jonkel 1982a, Zager and Jonkel 1983).
- schedule construction times to avoid seasonal use periods (Anonymous 1980).
- construct roads with takeoffs on cutbanks or steep slopesides to facilitate closure and obliteration (Contreras 1983).
- upper road reaches should be seeded with woody trees or shrubs to discourage bear use of roads as travel corridors (Erickson 1977).

Road Closures

Jonkel (1982a) suggests an aggressive road closure program of already established roads. Public education on the reasons for limiting access, and a strong enforcement program are essential to road closure programs. Roads which should be closed include:

- specified access roads should be closed after harvest and restocking (Ruediger and Mealey 1978, Contreras 1983, USFS 1985abc).
- temporary roads and landings should be obliterated allowing natural conifer regeneration or conifer restocking where shrubs are not suitable (Contreras 1983).
- collector roads should be closed except for emergencies or harvest re-entry (Contreras 1983).
- local roads should be closed within 1 season after use (Contreras 1983).
- "loop" roads should be closed when possible (Zager and Jonkel 1980).
- seismic trails and roads created during seismic operations should be closed after operations have ceased (Aune and Stivers 1983).

Open road densities should be reduced as determined in the biological evaluation. This generally involves closure of all local roads resulting in an average density not to exceed .75 miles/section (USFS 1985g). The Gallatin National Forest, Proposed Forest Plan (USFS 1985b) recommends density levels equivalent to >80% elk habitat effectiveness (the measure of how road density effects elk habitat) in Situation 1 areas and >60% in Situation 2 (as density increases, habitat effectiveness decreases).

Roads can be closed by physical barriers, gates or other means (Anonymous 1980, USFS 1985g, Holland 1986) but permanent closure with obliteration is more effective than

just posting or gating the road (Jonkel 1982a, Zager and Jonkel 1983). The Bridger-Teton Forest Plan (Contreras 1983) specifies alterations to be made on closed roads. These include:

- obliterate roads, including scarification, water-barring and revegetation of exposed soil.
- pull downfall back over the road.
- operate equipment carefully during restoration to protect adjacent shrubs and trees.
- reshape a length of the roadbed to natural conditions to reduce road visibility from open roads.
- pull culverts and remove bridges.

Road Use Restrictions

When roads cannot be permanantly closed, restrictions can be placed on their use to minimize disturbance to grizzlies. Road restrictions other than permanant closure can be (Ruediger and Mealey 1978):

- closed permanantly to the public, regulated use by park or forest personnel.
- regulated use by park or forest personnel, intermittently open for public use.
- intermittently open to both the public and park or forest personnel.

Restrictions might include:

- seasonal closing if grizzly use is seasonal (USFS 1983b, 1985a).
- opening roads for short time periods such as for wood cutting (USFS 1983b, 1985b).
- limiting nonessential traffic during logging operations (Zager and Jonkel 1983).
- restricting speed using speed bumps and strict enforcement (Jonkel et al. 1981).

In addition to careful management of existing and potential road systems, roadless timber harvest alternatives such as long distance skidding, aerial yarding, helicopter logging and use of helicopters in energy exploration should be encouraged (Ruediger and Mealey 1978, Anonymous 1980, Contreras 1983).

RECREATION

Recreational use of public lands, both consumptive and nonconsumptive, is increasing and wild land users are penetrating into more remote areas (Schallenberger and Jonkel 1979). Public use of backcountry may be detrimental to grizzly bear populations and will almost certainly create grizzly/human conflicts. Recreational camping increases the availability of food and garbage and camps are often located in prime grizzly use areas such as stream and river bottoms (Schallenberger and Jonkel 1980). In some areas, hunting pressure and nonconsumptive uses of grizzlies (i.e., observing, photographing) may allow *direct* impacts to bear populations in the future (Anonymous 1980). To promote visitor safety, and reduce the risks of grizzly bear mortality, National Parks and Forests are providing public education programs, regulating campgrounds, campsites and other recreational facilities and restricting visitor use of certain areas. All campgrounds, campsites, picnic areas, trails, roads, visitor centers, proposed resorts, cabins and base camps should be evaluated for their compatibility with grizzly management objectives (Table 34) (USFS 1982, 1985abc).

Campground/Campsite Management

Public education may be the most effective method of managing campgrounds and backcountry campsites. Information should be distributed to the public about proper food and garbage storage and removal and appropriate camping practices (USFS 1982, 1985abc, Brannon 1984). Campgrounds should be kept clean and free of food and refuse and should be located away from prime grizzly habitat (Schallenberger and Jonkel 1980). Specific recommendations for campground/campsite management are:

- food and food odors should be kept away from sleeping areas (Schallenberger and Jonkel 1980).
- traditional campsites should be avoided in grizzly habitat as bears may have become habituated to such areas (Schallenberger and Jonkel 1980).
- tent camping should be encouraged over sleeping in the open with no protection. Although a tent while not provide safety from marauding bears, it may act as an early warning device (Schallenberger and Jonkel 1980).
- use of established, nondeveloped, campsites should be adjusted to prevent odor buildup and/or habitual use by grizzlies (USFS 1982, 1985abc).
- only essential facilities should be developed at designated campsites and minimal public facilities should be provided at popular locations (USFS 1985i).
- solid waste disposal facilitites should not be provided at campgrounds; all solid waste should be packed out (USFS 1985i).
- garbage containers at developed campgrounds should be made bearproof and garbage pickup should occur frequently to prevent odor buildup or spillage (USFS 1982, 1985abc).
- recreational cabins create problems through improper food and garbage handling and storage (Schallenberger and Jonkel 1980). All cabins should be bearproofed in grizzly bear country (Zager and Jonkel 1980).

Trails and Backcountry Management

Roads and trails are usually constructed to follow the easiest travel routes through backcountry areas. Likewise, these travel routes are preferentially used by other wildlife, including grizzly bears (Schallenberger and Jonkel 1980). Roads and trails should be evaluated for their impact on grizzly bear habitat quality. Specific recommendations for regulating trail and backcountry use are:

- provide signs at trailheads and backcountry sites identifying grizzly habitat and recommending appropriate human conduct (USFS 1982, 1985abc).

Table 34. Management actions and monitoring levels following bear sightings and/or incidents in the Targhee National Forest (Matejko 1985).

	Management Situation 1					
	Sighting			Incident		
	>2 miles	<2 miles	on site	>2 miles	<2 miles	on site
Campgrounds	A - 3	A - 2	C - 2	C - 1	C - 1	C - 1
Summer Home Areas	—	—	—	—	—	—
Dispersed Recreation	A - 3	A,B - 2	A,B,C-2	C - 1	C - 1	C - 1
Timber Harvest	A - 3	A,B - 2	A,B,C-2	C - 1	C - 1	C - 1
Outfitter-Guides	A - 3	A,B - 2	A,B,C-2	C - 1	C - 1	C - 1
Firewood Areas	—	—	—	—	—	—
Livestock Grazing	—	—	—	—	—	—

	Management Situation 2					
	Sighting			Incident		
	>2 miles	<2 miles	on site	>2 miles	<2 miles	on site
Campgrounds	—	—	—	—	—	—
Summer Home Areas	A - 3	A,B - 2	A,B - 2	B - 1	D,E - 1	C,D,E-1
Dispersed Recreation	A - 3	A,B - 2	A,B - 2	B - 1	C - 1	C - 1
Timber Harvest	A - 3	A,B - 2	A,B - 2	B - 1	C - 1	C,D,E-1
Outfitter-Guides	A - 3	A,B - 2	A,B - 2	B - 1	C - 1	C - 1
Firewood Areas	A - 3	A,B - 2	A,B - 2	B - 1	C,D,E-1	C,D,E-1
Livestock Grasing	A - 3	A,B - 2	A,B - 2	B - 1	C,D,E-1	C,D,E-1

Management Strategies

A — Personal Contact, alert to bear(s) presence, check for compliance regulations
B — Close area to tent camping
C — Close area until bear status is resolved
D — Consider use of repellents (noise or electric fence) or baiting with approval of the IGBC to avoid human/bear incident
E — Trap and relocate bear(s) if situation meets GYE Guidelines for nuisance status

Monitoring Levels

1 — Intensive — Continuous, while bears are active
2 — Moderate — Daily: morning and evening locations
3 — Limited Daily aerial flight or ground check for location

- trails or backcountry sites with a history of grizzly/human encounters and a documented increase in grizzly use may be closed temporarily in Management Situations 1 and 2 or permanently in Management Situation 1 (USFS 1982, 1985abc).
- when grizzly bear tolerance levels have been exceeded, backcountry use can be restricted through permit systems or reevaluation of commercial uses (USFS 1982, 1985abc).
- backcountry travel may be restricted to large parties (4+ people), parties on horseback or parties with motorized vehicles as most grizzlies avoid larger (and noisier) groups (USFS 1985b).

Consumptive Recreational Use Management

Recreational hunting is the primary consumptive use of grizzly bears throughout Alaska (Anonymous 1980). As hunting pressure increases, stronger regulations may be imposed to affect the number of hunters, season lengths and transportation methods. Such regulations can be properly used to allow an optimum sustained yield (see *Harvest Strategies* in this Compendium). In areas where harvesting grizzlies is not permitted, accidental mortality may still affect grizzlies populations. The following steps can be taken to reduce the risk of hunter induced grizzly mortality:

- eliminate the spring black bear season in grizzly habitat as untrained hunters may mistake a small

grizzly for a black bear (Schallenberger and Jonkel 1980).

- provide information to hunters on distinguishing black and grizzly bears (USFS 1982, 1985abc).
- modify black bear hunting regulations to reduce or avoid areas or times when they may conflict with grizzly use of an area (USFS 1982, 1985abc).
- issue special warnings to hunters in grizzly bear country (USFS 1982, 1985abc).
- provide anglers with information about grizzly use of streams and other riparian zones. Anglers should avoid fostering fish odors (Schallenberger and Jonkel 1980).
- hunters should keep camps clean and store game meat appropriately (see *Outfitters* in this Compendium).

GRAZING

The "Interagency Grizzly Bear Guidelines" state that grazing activities which adversely impact bear populations or their habitat will not be permitted in Management Situation 1 areas and establish conditions to ensure that grazing activities are compatible with grizzly management objectives. They specify that the bear population must not be reduced, bears must not become conditioned to livestock as food and livestock management must not interfere with the grizzly bears natural activities (USFS 1985e).

Proposed livestock and ranching operations within grizzly habitat will be evaluated for such impacts (Mealey 1979, 1986, USFS 1983b, 1985abc) before permits are issued. Specific problems encountered with livestock in grizzly habitat include:

- livestock competition for early spring browse (Servheen et al. 1981).
- livestock trampling and degradation of wetland sites used by bears (Servheen et al. 1981). Livestock may reduce the vigor or destroy fruit producing shrubs by compacting soil on wetland sites (Jonkel 1982a).
- attraction of bears to livestock and livestock boneyards increases their vulnerability to man-caused mortality as they become habituated to killing livestock (Johnson and Griffel 1982).

Range management plans in grizzly habitat should specify measures to protect (partially, or fully, depending on the management situation) important grizzly bear use areas (Mealey 1979, 1986, USFS 1982, 1983b, 1985bc). Where conflicts arise between grazing operations and grizzly objectives, adjustments will be made in favor of grizzly conservation in both Situations 1 and 2 (Mealey 1979, Contreras 1983, USFS 1982, 1985aabc, Knight and Judd (int. conf.)). General management guidelines for grazing allotment plans will:

- reflect the ecological needs of the grizzly bear.
- specify measures to meet Forest Service grizzly management objectives (Mealey 1979, 1986, USFS 1983b, 1985i).
- designate areas to be grazed and their season of use (Orme and Williams 1986).
- evaluate the potential for grizzly/livestock conflict (USFS 1985).
- include a clause for cancellation of permits if conflicts cannot be resolved (Mealey 1979, 1986, USFS 1983b, 1985i).

Specific suggestions for minimizing livestock damage to grizzly use areas include:

- regulate the number of livestock and season of use in important grizzly feeding, loafing and travelling areas (Summerfield 1978, Mealey 1979, 1986, Jonkel 1982, Zager and Jonkel 1983, USFS 1983b).
- defer livestock grazing in important spring habitat until after June 15 (Servheen et al. 1981) or July 1 (Aune and Stivers 1982, 1985, USFS 1985c).
- use a rotation grazing system (Summerfield 1978, Contreras 1983).
- exclude cattle from sensitive grizzly areas (Mealey 1979, 1986, USFS 1983c, 1985abc).
- exclude cattle from clearcuts (Meyer 1978, Contreras 1983).
- fence riparian areas to exclude livestock if turnout date is prior to 1 July (Mealey 1979, 1986, Servheen et al. 1981, Aune and Stivers 1985). Drinking and crossing areas should be placed to avoid bear use areas.
- protect areas of aspen regeneration; do not allow grazing of aspen seedlings in more than 1 out of every 3 years (Contreras 1983).
- seed erosion areas and protect from damage by fencing or placement of slash and logs (Summerfield 1978).
- manipulate habitat by burning to maintain transitional habitat for both grizzlies and cattle (Summerfield 1978) (see *FIRE* in this Compendium).
- close roads not essential for grazing allotments (see *ROADS* in this compendium) (Summerfield 1978).

Riparian areas — including streamsides, seeps and springs and mesic stands of aspen are especially important to grizzlies and may also receive a high level of grazing use. The Forest Service suggests designating streamsides as distinct management areas for specific grazing practices. Their recommendations follow:

- streamside pastures may benefit most from a deferred rotational grazing system or may require complete rest to restore damaged vegetation.
- utilization or trampling of grizzly food plants (especially succulent herbs, starchy roots and fruiting shrubs should not exceed 40% of what is available.
- streambank stability should be maintained for at least 80% of the linear distance along streamsides.
- stock driveways and herding areas should be kept away from streamsides.

- diet supplements (salt/mineral blocks) and shade trees should be used to draw livestock away from streams.

Bear depredation of livestock is a problem where rangeland overlaps important grizzly use areas or where poor range practices attract bears to grazing allotments. Management practices designed to minimize bear depradation on livestock are listed below:

- only qualified herders should be used in grizzly habitat (USFS 1981).
- camps should be maintained in conditions that reduce the chances of attracting bears; food and garbage should be made unavailable (Griffel 1978, Lee and Weaver 1981, Servheen et al. 1981, Franklin and Matejko 1983, USFS 1983b, 1985bc) (see *Outfitters* in this Compendium).
- bedding grounds should be changed at least every 2-3 days and preferrably each day; traditional bedding grounds should be avoided (Lee and Weaver 1981, Mehrhoff 1981, Griffel 1982, Franklin and Matejko 1983).
- herders should maintain tight groups so that sheep become conditioned to not leaving bedding grounds without herder initiation (Mehrhoff 1981, Griffel 1982).
- herders should "teepee out" with their herd (Griffel 1978, Lee and Weaver 1981, Mehrhoff 1981, Franklin and Matejko 1983).
- allotment plans should specify measures for removal and treatment of livestock carrion and boneyards (Griffel 1978, Mealey 1979, 1986, Servheen et al. 1981, Aune and Stivers 1982, 1985, Zager and Jonkel 1983, USFS 1982, 1983b, 1985b).
  - carcasses should be removed immediately after death (Servheen et al. 1981).
  - carcasses may be treated chemically, although close monitoring for chemical impacts must take place (Servheen et al. 1981).
- diseased livestock should be confined away from houses, livestock enclosures and calving grounds, but should not be abandoned to be "cleaned-up" by bears (Jonkel 1982a, Zager and Jonkel 1983).
- an electric fence can be used to keep bears away from sheep (Matejko and Franklin 1983).
- monitoring level should be intensive; areas should be searched for bear sign before entering and after leaving; sheep losses should be noted and reported (Griffel 1978, Summerfield 1978, Mehrhoff 1981, Franklin and Matejko 1983, Matejko 1985, USFS 1985, Orme and Williams 1986).

Where depredation has occurred, options range from changing herding practices to removal of the nuisance bear. Specific suggestions follow:

- season of livestock use, bedding practices or grazing area should be changed (Mealey 1979, 1986, USFS 1982, 1983b, 1985be).
- berry patches which often occur on steep, brushy slopes and are generally unsuitable as sheep range should be avoided (Jorgenson 1983).
- livestock should be moved to another part of the allotment (USFS 1985b).
- livestock should be moved and allotments should be closed (Mealey 1979, 1986, Mehrhoff 1981, Lee and Weaver 1981, Servheen et al. 1981, Johnson and Griffel 1982, USFS 1982, 1983b, 1985b, Matejko 1985, Orme and Williams 1986); restock only after the allotment has been reevaluated.
- livestock class should be changed from sheep to cattle if the range is suitable; sheep are more susceptible to bear predation. Move sheep outside Management Situation 1 sites (Knight and Judd 1978, Lee and Weaver 1981, USFS 1982, 1985b).
- a monitoring system should be implemented (Mehrhoff 1981, USFS 1982, 1985b, Orme and Williams 1986).
- portable corrals, sheep protecting dogs or other aversion methods should be used (Jorgenson 1983).
- the grizzly should be relocated away from the allotment if it is determined to be a nuisance (i.e., if the bear follows sheep after they have been relocated to another area of the alottment resulting in 2 or more attacts) (USFS 1985b).
- use repellents and baiting only with IGBC approval (Matejko 1985). Alternate management methods, less acceptable, or feasible include:
- converting sheep allotments to cattle allotments because of unsuitable terrain, forage or fencing costs (Lee and Weaver 1981).
- damage payments to permit holders for bear depredation (Lee and Weaver 1981).
- shooting or governmental trapping of nuisance bears (Lee and Weaver 1981):
  - a unit should be closed if a herder shoots or shoots at a bear (Mehrhoff 1981).
  - permittees should not use traps, snares or poison to control black bear predation as these may accidentally take grizzlies (Lee and Weaver 1981, Matejko and Franklin 1983, USFS 1985b, Orme and Williams 1986).
- hazing bears (Matejko and Franklin 1983, USFS 1985b).

Grazing permits will include a statement warning that any violation of the ESA (including shooting a grizzly) would be grounds for cancelling the permit (Summerfield 1978, Lee and Weaver 1981, Orme and Williams 1986).

SUBDIVISION

Housing construction in bear habitat inevitably creates conflict. Because bears are not inhibited by the presence of subdivisions in their traditional habitat as long as surrounding cover is available, the introduction of man-related foods (garbage, swine, fruit trees and livestock) often leads to behavioral changes in the bears and related human/bear confrontations (Jonkel et al. 1978, Servheen et al. 1981). Habituation to man, with concurrent behav-

ioral chanages, can be passed down through maternal training and thus will continue until the offending bear is moved or eliminated. The best way to minimize such conflicts is to identify potential development areas (Servheen et al. 1981) and allow wildlife agencies to review subdivision plans (Johnson and Jonkel 1976). However, these lands are private, and are not subject to any direct agency management requirements. Thus, the management strategies available for private lands are:

- zoning (although this has not generally met with acceptance).
- conservation easement of important habitat.
- acquisition (the Nature Conservancy and other organizations have been active in acquiring ecologically significant habitat) (Servheen et al. 1981).

Floodplains are popular for subdivision construction, particularly in mountainous areas where other large, flat expanses of land are unavailable. Jonkel et al. (1978) suggest that subdivisions on floodplains in the North Fork Ranger District of Montana will permanantly alter grizzly use of these areas. They indicate that housing developments will reduce bear use of riparian feeding sites, reduce travel cover for bears moving through the area, reduce general "roaming" areas and cause a dramatic increase in grizzly/human conflicts. This suggests that cabin and subdivision construction should be discouraged in sensitive grizzly use areas, particularly riparian areas and travel corridors such as creek bottoms, ridgetops, narrow canyons and timber corridors (Zager and Jonkel 1980). In areas where human development and grizzly habitat already overlap, subdivisions should be managed in cooperation with landowners to minimize attractive foods near residences. Specific recommendations are:

- remove fruit trees or harvest fruit in a timely manner (Servheen et al. 1981).
- remove or incinerate garbage quickly (Zager and Jonkel 1980).
- store odiferous foods in jars or metal containers; do not leave food in unattended cabins unless it is properly stored (Zager and Jonkel 1980).
- use discretion when feeding dogs bones, meat scraps, etc. (Zager and Jonkel 1980).

An effective public relations program should also be initiated to explain the importance of low elevation habitats to grizzlies (Servheen et al. 1981).

FIRE

Management practices that encourage fire suppression have substantially altered the natural succession of many western forests (Lee and Jonkel 1981, USFS 1985e Holland 1986). In most cases, the elimination or reduction of early successional stages has had a negative impact on grizzly bear habitat, particularly on grizzly food production (Martin 1980, Zager 1980a, USFS 1983b, Zager et al. 1983, Holland 1986). Mesic sites have been particularly affected by fire suppression. Natural fire frequency appears necessary to maintain or expand habitat components positively influenced by burning (Mealey et al. 1977, Mealey 1979, 1985, USFS 1983b). New let-burn policies and management prescription burns will simulate traditional fire regimes and allow the growth of seral shrub stages that are more compatible with grizzly bear requirements (Davis et al. 1976, Mealy et al. 1976, USFS 1985a). These new policies are often applicable in wilderness areas. Forest fire guidelines in wilderness areas permit lightning caused fires to burn and allow prescribed burns to reduce levels of fuel in excess of that which would exist before fire suppression regimes (USFS 1985e).

The evaluation of fire management activities by Forest Service district rangers or biologists can ensure that grizzly bear requirements are considered in management plans (USFS 1982, 1985abc). Forest level fire management plans should be developed to incorporate prescribed burning as a management tool where it can benefit grizzly habitat and not conflict with other resources (e.g., watersheds, old growth, regulated timberlands) (USFS 1985a). Planned ignitions may become necessary where lightning fires do not occur frequently enough, or where the risks of allowing unplanned fires to burn are unacceptable. Unplanned fires in areas where excessive fuel has accumulated due to historic fire suppression may result in single age class stands which provide less habitat diversity for grizzly bears.

Prescribed burning can be used to improve grizzly habitat both as a direct habitat management technique and as a site preparation technique, particularly at higher elevation sites not managed for timber production (Mealey et al. 1977, Martin 1980, Mealey 1979, 1985, USFS 1983b, 1985ab). Such activities should be scheduled during seasons and at times of low grizzly activity (USFS 1982, 1983b) and security areas should be provided immediately adjacent to burn activities (USFS 1985b). Prescribed burning can be used as a tool to:

- approximate natural fire frequency (USFS 1983b, 1985b).
- reduce conifer litter, release nutrients tied up in the litter and rejuvenate plants (Zager 1980a).
- create openings which support berries, bulbs and other important grizzly foods (USFS 1985ae).
- reverse the loss of seral brushfields by reducing conifer encroachment (Zager et al. 1983, Holland 1986).
- convert old, decadent stands of whitebark pine to younger age classes (Eggers 1986).

Burning will be beneficial in improving grizzly habitat in:

- mesic, montane sites (Zager et al. 1983).
- WBF/AF, AF/LUHI/MEFE, AF/LUHI/VASC, and AF/XETE/VAGL habitat types (Mealey et al. 1977).
- whitebark pine stands (Eggers 1986).
- subalpine fir/whitebark pine, pine/grouse whortleberry and subalpine fir/huckle berry habitat types (USFS 1985b).
- aspen and willow stands (when maintenance of stand dominance is desired) (USFS 1985bi).
- ABLA-PIAL/VASC habitat types (USFS 1985b).

Garcia (1986) presents a detail summary of fire management activities conducted on Kootenai National Forest. Several successful projects are described as to procedures, costs and personnel.

For fire crew safety, the following procedures are recommended:

- Fire management contractors should be informed when working in bear country (USFS 1985b).
- Temporary living facilities should be closely monitored; refuse removal will be required by all contracts (USFS 1985abc) (see *Outfitters* in this Compendium).

MINING, OIL AND GAS DEVELOPMENT

Current research shows that limited energy and mineral development can take place in grizzly use areas without adverse affect on grizzly bears (USFS 1980). Mineral, gas, oil and geothermal exploration require operating plans and special use permits which must include specific measures to protect, maintain or improve grizzly habitat where applicable (USFS 1979, 1983b, 1985b). Permits must include a provision for cancellation or temporary cessation of activities if deemed necessary to prevent conflicts with grizzlies.

Exploration/development activities which would adversely affect grizzly populations or habitat quality, or quantity, will not be permitted in Management Situation 1 areas and should be avoided in Management Situation 2 areas (USFS 1979, 1983b, 1985b). Adverse impacts include:

- land surface disturbance.
- water table alteration.
- reservoirs, rights-of-ways, roads, pipelines, landings, transmission lines or other structures.
- increased availability of human food.
- reduced availability of natural food.

Oil, gas and mineral exploration/development operations may be compatible with grizzly management if the following conditions are adhered to:

Seasonal or Temporal Constraints

In general, activities should occur at a time or season of little biological importance to grizzly bears (mid-summer and winter months) (USFS 1979, 1980, 1983b, 1985b, Zager and Jonkel 1980, 1983). Pipeline activity/construction should be restricted to periods of low bear activity (Aune and Stivers 1983). Seasons during which activity should be avoided are:

- denning season (approximately mid-October through mid-May) (USFS 1980, Aune and Stivers 1982, Aune and Stivers 1983, Schoen et al. in press a).
  - no seismic activities or drilling should take place within 2 miles of den sites between 15 October and 15 April (Aune and Stivers 1982, 1983).
  - activity should be prohibited within 1 mile of identified denning habitat from 15 November-10 May (USFS 1980).
  - seismic lines travelling through denning habitat or within 1 mile on either side should not be run until after den emergence (approximately May 10) (USFS 1980).
- den entry (October — mid-November) (Schoen et al. in press a).
- den emergence (April-May) (Schoen et al. in press a).
- breeding season (April 1 — 30 June) (USFS 1980, USFS and BLM 1985).
- 10 days prior to the start through the end of big game hunting season (USFS 1980).

Other recommendations for reducing energy development impacts on grizzly bears by means of temporal restrictions are:

- seismic activity should be postponed if den monitoring indicates that family groups remain in the area (USFS 1980).
- drilling schedules can be staggered on adjacent sites to provide a disturbance-free zone for displaced bears (Aune and Stivers 1983, USFS 1985c).
- helicopter flights and blasting should take place only between 1 hour after sunrise and 1 hour before sunset (Aune and Stivers 1983).

Location of Activities

Field operation centers should not be placed in seasonally important habitat (Aune and Stivers 1983). Specific spatial considerations for energy exploration in grizzly habitat are:

- seismic lines should be located away from wallows, mineral licks, water holes, bedding sites, nests and dens (USFS 1980).
- concurrently active seismic lines should be spaced at least 8-10 air miles apart to provide a disturbance free zone for displaced animals (Aune and Stivers 1982, 1983, 1985):
  - lines should be separated by a topographic screen or other cover (Aune and Stivers 1982). McLellan and Mace (1985) found that bears were not displaced by seismic activity if they were in cover.
  - survey crews from one line can work between active lines (Aune and Stivers 1982).
- directional drilling and remote mine mouths can be used in sensitive areas (Zager and Jonkel 1980, 1983).
- reserve pits can be fenced or flagged (USFS 1979).

Waste Disposal

Solid waste disposal transfer stations should be made compatible with grizzly management objectives (USFS 1985b) and the integrity of aquatic systems and riparian

zones should be maintained. All waste water associated with drilling should be disposed of in an approved manner (USFS 1979, 1983b). Lessees will be responsible if systems are polluted or damaged (USFS 1979, 1983b).

Roads

Road management plans should be integrated in the operations plan (Zager and Jonkel 1980, 1983, Aune and Stivers 1985, USFS 1985b) (see *ROADS* in this Compendium). Specific recommendations are:

- minimum road standards should be used (USFS 1983b, Aune and Stivers 1985, Horejsi 1986a).
- roads should be located to avoid important bear use areas (Aune and Stivers 1985).
- road construction should be scheduled to minimize disturbance seasonally (Aune and Stivers 1985).
- roads should be single purpose and closed to the public (USFS 1979, Aune and Stivers 1983, 1985).
- roads should be reclaimed using native plants where possible after operations cease (USFS 1979, 1983b, Aune and Stivers 1983, 1985).

Alternatives to Roads

There are several alternatives to road construction for servicing mineral exploration areas. These include:

- servicing well heads by helicopter to reduce road construction (Aune and Stivers 1985, Horejsi 1986a). However, as aircraft may disturb grizzly bears and their habitat, requirements for helicopter use are:
  - — establish helicopter flight patterns before flying (Aune and Stivers 1983, USFS 1985c) (See *Aircraft* in this Compendium).
  - — locate flight corridors to avoid seasonally important grizzly habitat; breeding areas (1 May - 1 July), denning areas (15 October - 15 April) and open alpine areas (1 July - 15 September).
  - — make flight corridors no more than 1/2 mile wide along seismographic lines, between landing zones and lines and between landing zones and other operations unless safety precludes this (Aune and Stivers 1985).
- well facilities can be operated by computer (Horejsi 1986a) and monitored using telemetry (USFS and BLM 1985) to reduce the need for accessing the well site.

Camps

Off-site camps should be encouraged, but on-site camps can be made compatible with grizzly management objectives if camp regulations are carefully followed (Zager and Jonkel 1980, 1983, USFS 1985bc) (see *Outfitters* in this Compendium). A brief summary of camp regulations follows:

- food should be properly stored.
- garbage should be disposed of properly (USFS 1979, 1985bc).
- dogs should be prohibited from camps (Aune and Stivers 1985).
- firearms should be prohibited from camps (Zager and Jonkel 1980, 1983, Aune and Stivers 1985, Horejsi 1986a).
- camps should be located away from riparian areas or other known or suspected travel routes (Zager and Jonkel 1980, 1983).
- crews can be bussed to, and from, camp and drill sites to minimize activity (Zager and Jonkel 1980, 1983, Aune and Stivers 1985).

General

Other general recommendations for making energy exploration compatible with grizzly bear management objectives are:

- hunting should be prohibited in exploration areas (Zager and Jonkel 1980, 1983, Aune and Stivers 1985, Horejsi 1986a).
- permit holders should log their daily activities to assess wildlife impacts (Aune and Stivers 1983). Records should be kept on shift change times, shut down/start up times, changes in noise or activity levels, and location of seismic crews (Aune and Stivers 1985).
- noise levels should be kept to a minimum by muffling engines, generators and production facilities (Aune and Stivers 1985).
- drilling pads and other areas in Management Situation 1 denuded by mining exploration should be reclaimed by lessee as directed by the Forest Service (USFS 1983b).

AIRCRAFT

While little information is available about the direct effects of air traffic on grizzly bears, studies of brown bears in Alaska indicate that aircraft disturbance may be a significant problem, particularly in areas where helicopters are used as alternatives to new road construction and for logging and energy exploration/development (Aune and Stivers 1980). Heavy helicopter traffic may disturb bears particularly during the denning season (Schoen et al. in press a). Suggestions for minimizing aircraft disturbance are:

- minimize traffic during the denning period, particularly during den entry (October - mid-November) and emergence (April - May) (Schoen et al. in press a).
- schedule helicopter flights between 1 hour after sunrise to 1 hour before sunset from 15 April to 15 October (Aune and Stivers 1982, 1983).
- maintain a minimum helicopter altitude of 183 m (600 ft) (Aune and Stivers 1980).

- establish helicopter flight patterns of less than 1/2 mile width along all seismic lines, between landing zones and between landing zones and other operations except where flight safety precludes this (Aune and Stivers 1980).
- designate landing zones with adequate visual or topographic barriers (Aune and Stivers 1980).

Helicopter use, while discouraged in wilderness settings, may become necessary to move bears for genetic, demographic or behavioral purposes. Helicopters will not be permitted in wilderness areas unless it is deemed to be the only feasible method to meet grizzly recovery objectives (USFS 1985).

CUMULATIVE EFFECTS ANALYSIS

Cumulative effects has been defined as "the combined effect upon a species or its habitats caused by the activities or programs at hand, as well as other reasonably foreseeable events which are likely to have similar effects upon that species or its habitats" (Weaver et al. 1985, USFS 1986). Such effects can result from "individually minor but collectively significant events taking place over time" (Weaver et al. 1985, USFS 1986). Cumulative effects analysis (CEA) is "an assessment of how the combination of natural processes and events and man's activities cause resources and environmental conditions in an area to change over time" (Salwasser and Sampson 1985). It has becoming an integral part of evaluating the impacts of man's activities on grizzly bears and grizzly bear habitat both temporally and spatially (Hadden and Jonkel 1983, Christensen et al. 1984, 1985, Salwasser and Samson 1985).

The purpose of cumulative effects analysis is to help managers make optimal land use decisions and allow them to simulate additive, as well as individual effects of various activities. It serves as a resource assessment and prediction tool for agencies (Hadden and Jonkel 1983, Salwasser and Samson 1985). Specifically, it can be used to:

- analyze the effects of existing and proposed activities on grizzly bear habitat (Christensen and Madel 1982).
- serve as a tool for coordinating diverse land management activities to provide adequate habitat for bears (Christensen and Madel 1982).
- provide a method of comparing watersheds (quantitatively and cartographically) (Christensen and Madel 1982).
- provide recognizable boundaries for managing bears (Christensen and Madel 1982).
- help managers identify permit requirements, schedule demands and identify constraints necessary to preserve important grizzly habitat while meeting other resource needs (Christensen et al. 1985).
- set upper and lower limits of grizzly spatial needs (Christensen and Madel 1982).
- help managers determine which land uses contribute the most to cumulative effects and whether habitat per se, habitat use or grizzly survivorship is influenced (Christensen et al. 1985).

Criteria for focusing CEA procedures are to recognize *all* ongoing management activities which may impact grizzlies (Christensen and Madel 1982), address a large enough area to encompass all major factors affecting grizzlies (Salwasser and Samson 1985), but consider only major causes and effects (Salwasser and Samson 1985) and distinguish between natural and man-induced causes and effects (Salwasser and Samson 1985).

Christensen et al. (1985) identified the following steps needed to carry out a CEA:

- identify and quantify habitat both spatially and temporally.
- quantify the effects of forest uses.
- define a procedure to measure these combined effects (for example, scoring systems).
- relate the results of the CEA to grizzly bear population viability and recovery.

Cartographic modelling has been used in some CEA appraisals (Winn and Barber 1986). A cumulative effects model of this type can enhance management decision by providing managers with a quantified and graphic representation of habitat values and mortality risks for existing and potential situations (USFS 1986). Mapping of all available grizzly habitat, habitat components and CEA data has also been identified as a priority by Christensen and Madel (1982), Haddon and Jonkel (1984) and Christensen et al. (1983). They indicate that mapping should:

- identify components on the basis of bear foods and den site availability (Christensen and Madel 1982, Christensen et al. 1985).
- describe other important factors such as cover and isolation (Christensen and Madel 1982).
- provide overlays which depict road access, zones of influence, land management activities, recreational and mineral activities and other influences which impact grizzly habitat (Christensen et al. 1985).
- divide habitat into subunits based on USFS Management Situation stratification to (Weaver et al. 1985, Winn and Barber 1986):
  - assess existing and proposed activities without having the diluting effect of an overly large area (Weaver et al. 1985).
  - match individual bear-use patterns and habitat ecology (Weaver et al. 1985).
  - prioritize areas where management would require CEA (Weaver et al. 1985).
- calculate subunit habitat values according to the value of the following habitat components (Weaver et al. 1985):
  - presence of ungulates.
  - presence of trout spawning streams.

- interspersion of forest and nonforest components.
- equity of seasonal feeding opportunities.
- habitat diversity.

The Greater Yellowstone Ecosystem and the Rocky Mountain Front cumulative effects models consist of 3 submodels (USFS 2986, Winn and Barber 1986); habitat — the capacity to support bears based on food, cover and edge indices; displacement — the measure of grizzly bear's ability to use the area based on human activity; and mortality — an assessment of the grizzly mortality risks associated with human activities.

The habitat submodel is designed to indicate year long habitat quality and includes information on (Weaver et al. 1985):

- food and thermal cover.
- habitat diversity.
- seasonal equity.
- denning suitability.

The displacement submodel quantifies the displacement effects associated with human use and activities on grizzly bear ability to use an area (USFS 1986). It includes data on (Weaver et al. 1985):

- type of activity — motorized, nonmotorized, explosive.
- nature of activity — linear, point, dispersed.
- length of activity — diurnal, 24 hour.
- disturbance intensity — high vs. low.

The mortality submodel quantifies the risk of mortality associated with human activities (USFS 1986). Data includes (Weaver et al. 1985):

- habitat quality.
- nature of activity.
- intensity of use.
- availability of attractants.
- presence of firearms.

The habitat and displacement models are used to derive a habitat effectiveness index while the mortality model provides data for a mortality risk index. The completion of cumulative effects models involves establishing and validating threshold levels (Weaver et al. 1985) which represent the minimum acceptable levels of habitat effectiveness and mortality risks required for a species to recover and should include energetic and spatial needs of grizzly bears under worst case situations (Weaver et al. 1985, USFS 1986, Winn and Barber 1986). Because the Endangered Species Act requires cumulative effects analysis of all land uses and management activities that might impact listed species (Weaver et al. 1985, USFS 1986), use of CEA has become standard procedure. The results have benefitted grizzly habitat management, enhanced public appreciation of U.S. Forest Service land management credibility and decreased the number of legal actions against the USFS (Christensen et al. 1985). The details of specific cumulative effects analysis models and procedures are presented in the papers cited in this narrative. The reader is referred to these papers for a more detailed description of CEA.

OUTFITTERS

Human food and refuse, livestock food and wildlife carcasses associated with outfitter camps provide strong attractants for grizzly bears. Bears can become positively conditioned to associate human camps with these attractants, increasing the opportunity for grizzly/human conflicts. Grizzly/human interactions can be minimized by proper storage, handling and disposal of these attractants.

In 1985, the National Park Service and the Forest Service listed provisions for grizzly bear protection to be considered in Outfitter Operations Management Plans or Special Use Permits. The following points should be considered and will be elaborated upon in the following sections.

1. Camp location and time period of use
2. Areas to avoid
3. Seasonal or other human activity limitations
4. Restrictions on livestock or pets by location, numbers, types, and treatment of carcasses
5. Food storage for livestock, pets, and humans
6. Garbage and refuse disposal
7. Game meat storage
8. Legal provision

Camp Location

- use of established campsites will be adjusted to prevent odor build-up (Mealey 1979, 1986, USFS 1983b, 1985a).
- each outfitter will prepare an operating plan that details camp layout and specifies arrangements that will be made to make human food, garbage, livestock and pet food and game meat unavailable (USFS 1985abc).
- camp layout should maximize distances between food sources and human quarters and bear cover (Hoak et al. 1983).
- all sleeping tents and sleeping areas will be located at least 100 yards from any wildlife carcass or parts (Hoak and Clark 1979, NPS and USFS 1985).
- quotas should be established to limit the total surface area of outfitting areas (Lortie 1978).
- impacts of outfitter camping and livestock grazing will be evaluated to assure that important grizzly habitat is not degraded or compromised (USFS 1982, 1983b).

Areas to Avoid

- hunters will be issued special warnings when using habitat frequented by grizzly bears and will be provided with information on distinguishing black and grizzly bears (USFS 1985abc).

- black bear hunting regulations can be modified to reduce or avoid areas that conflict with grizzly habitat (USFS 1985a).

Temporal Limitations

- all permits will include provisions for cancellation or temporary cessation of activities if grizzly/human conflicts arise (USFS 1983b).

- black bear hunting regulations can be modified to reduce or avoid time periods sensitive to grizzlies (USFS 1985abc).

Restrictions on Livestock or Pets

- the impact of livestock grazing will be evaluated to assure that important grizzly habitat is not compromised (USFS 1982, 1983b).
- livestock carcasses must be destroyed or removed from within 1/4 mile of trails and 1/2 mile from camps (NPS and USFS 1985).
- dogs can actually be an asset in camp by discouraging bears and warning campers of bear approaches (Wood 1985a).

Food Storage

- a pack in-pack out philosophy should be adopted by all outfitters, and no livestock or human food should be available to bears (USFS 1985b).
- outfitters will be encouraged to limit the quantity of horse and human food to that necessary for each trip (USFS 1985b).
  - managers may wish to restrict the use of horse grain mixtures containing sweeteners such as molasses which act as attractants (Henry 1984).
- food should be properly stored in a manner which is reasonably safe in the presence of humans, has been demonstrated to be bear proof and is unobtrusive (NPS and USFS 1985).
- native materials should be used when possible. Facilities constructed of non-native materials should be removed from wilderness areas at the end of each season (NPS and USFS 1985).

Four types of bear-proof storage facilities are: storage boxes, raised platforms or cargo net platforms, electric fences, and meat poles (Wood 1985a). The Interagency Grizzly Bear Commission Task Force requirements for these storage facilities follow (Henry 1984):

- Bear proof food storage boxes should be:
  - not more than 150 pounds
  - completely or partially pre-fabricated to facilitate assemblage in backcountry
  - constructed of 12 gauge steel or material of similar strength
  - tested to be grizzly proof
- Raised platforms appear to be a reasonable method of securing large quantities of foods or other bear attractants. They are the most appropriate means of storing horse food (Wood 1985a). Platforms should be:
  - replaced by a 50-55 gallon barrel if this is more appropriate. The barrel can be suspended or buried. If it is stored above ground, several barrels can be attached together and secured to a tree (Henry 1984).
  - approved by the resource manager on a case by case basis as a variety of designs are available
  - made of native material with a ladder for access
  - used in conjunction with stovepipes tacked around trees to prevent platform access by bears
- Electric fences can be used for isolating horse and human food and refuse but:
  - a much greater risk is involved due to human error, weather conditions and mechanical failure (Wood 1985a)
  - they cannot be used near cooking, dining or tent areas (Wood 1985a)
  - caution is necessary as some bears respond to electric shock by looking for something to strike out against (Henry 1984)
- While various designs are available for camp poles, several requirements are necessary:
  - poles should be at least 15 feet tall (from the ground) so that all items are suspended at least 10 feet from the ground and 4 feet from any vertical surface (NPS and USFS 1985)
  - poles should be inconspicuous so they need not be dismantled (NPS and USFS 1985)
  - poles must be able to support 1000 lbs. on a 20 ft. span (Henry 1984)
  - support lines should be made from cable, steel or material of similar strength (Henry 1984)
  - poles should be located a minimum of 100 yards from sleeping tents or sleeping areas unless a district ranger approves a shorter distance (NPS and USFS 1985)
  - poles should be tested to be bear proof (Henry 1984)
- Where food sources cannot be bear-proofed or where odors remain, mothballs or napthalene crystals can be used as repellents (Hoak et al. 1979, 1983).

Garbage and Refuse Disposal

- food containers or emptied containers should not be buried unless they are stored in bear proof drums. Even empty food cans can be associated with food (Hoak and Clark 1979).

- food or food containers should not be left in caches between seasons (Hoak and Clark 1979, Hoak et al. 1983, NPS and USFS 1985).
- all combustible garbage should be burned (Hoak and Clark 1979).

Game Meat Storage

Suggestions for hanging game meat vary widely, but all sources agree that meat should be:

- hung at least 100 yards from camp and moved within 48 hours unless stored at least 1/2 mile from camp (Lortie 1978, Mealey 1979, 1986, NPS and USFS 1985, USFS 1983, 1985b, USFS and NPS 1985, Wood 1985a).
- A variety of requirements for suspension are:
  - — no less than 4.6 m (15 ft.) from the ground with suspension ropes at least 3.1 m (10 ft.) from the ground (Hoak and Clark 1979).
  - — no less than 3.3 m (10 ft.) from the ground, at least 1 m (3 ft.) from the nearest lateral object, and with suspension ropes tied off 2 m (6 ft.) or higher to an object other than that supporting the meat (USFS and NPS 1979).
  - — at least 2.2 m (10 ft.) from the ground and 1.3 m (4 ft.) from the nearest lateral object (Wood 1985a).
  - — at least 4.6 m from the ground, a minimum of 2 m between the meat and the nearest lateral object and 3.1 m between the suspension ropes and the highest access point (Wood 1985a).

Legal Provision

The NPS and USFS (1985) state that any failure to comply with the Outfitter Policy which results in injury or death to a grizzly may cause administrative or criminal action to be taken against the permit holder. Under the Endangered Species Act, an offender could be assessed a civil penalty of "not more than $10,000 for each violation upon conviction, be fined not more than $20,000 or imprisoned for not more than one year, or both."

GARBAGE

Grizzly bears are opportunistic feeders, and human supplied food and refuse may serve as attractants to bears, particularly in dry years (Hoak and Clark 1977). A large percentage of Yellowstone grizzly bears depend on human supplied food at garbage dumps (J.J. Craighead and F.C. Craighead, Jr. 1972). Success at obtaining food from campsites, campgrounds, recreational facilities, outfitter camps and cabins or summer homes reinforces this behavior often to the detriment of both grizzlies and humans; high grizzly bear mortality rates are associated with their attraction to human food sources (Anonymous 1980). Proper handling and disposal of garbage in human use areas can reduce the incidence of such conflicts. The following are recommendations for handling and disposing of garbage in an appropriate manner:

- all combustible garbage should be burned in enclosed campstoves at backcountry campsites. No garbage should be buried, including empty cans or other food containers as bears will still associate these with food (Hoak and Clark 1977).
- all garbage containers should be bearproofed and pickup should be frequent to minimize buildup of odors or spillage (USFS 1985abc).
- existing and potential garbage dumps should be evaluated to determine if a problem exists (or will exist). County officials should be asked to coordinate with Park and Forest Service personnel if a problem arises (USFS 1985a).
- operators with special use permits should be required to make all garbage unavailable to bears through the use of bearproof storage facilities and regular collection (USFS 1985a).
- nondeveloped campsite use should be adjusted to control improperly handled garbage and concurrent odor buildup (USFS 1985a).
- garbage pickup should be late in the day, every day, at developed sites where bears are known to frequent the area (USFS 1985b).
- trashcans which are not bear resistant (i.e, at employee residences, administrative offices, recreational residences) should be made unavailable to bears (USFS 1985b).
- loaded trash vehicles should proceed directly to transfer stations unless it is very late in the evening and the truck is stored in a closed building or fenced area (USFS 1985b).

APPENDIX A

COMMON AND SCIENTIFIC NAMES OF PLANTS DISCUSSED IN THE NARRATIVES

SCIENTIFIC NAME	COMMON NAME	SCIENTIFIC NAME	COMMON NAME
	Trees		
Pseudotsuga menziesii	Douglas fir	*Populus balsamifera*	balsam poplar
Pinus contorta	lodgepole pine	*Abies lasiocarpa*	subalpine fir
Thuja plicata	western red cedar	*Pinus albicaulis*	whitebark pine
Picea sitchensis	sitka spruce	*Pinus flexilis*	limber pine
Picea engelmannii	Englemann spruce	*Larix lyallii*	alpine larch
Picea glauca	white spruce	*Populus tremuloides*	trembling aspen
Picea mariana	black spruce	*Betula spp.*	birch
Abies amabilis	amabilis fir		
	Shrubs		
Alnus rubra	red alder	*Vaccinium scoparium*	grouseberry
Alnus sitchensis	sitka alder	*Vaccinium globulare*	globe huckleberry
Alnus crispa	mountain alder	*Vaccinium uliginosum*	alpine blueberry
Arctostaphylos uva-ursi	bearberry	*Vaccinium vitis-idaea*	lignonberry
Betula glandulosa	dwarf birch	*Ribes spp.*	currant
Cornus stolonifera	flowering dogwood	*Rubus parviflora*	thimbleberry
Empetrum nigrum	crowberry	*Rubus spectabilis*	salmonberry
Dryas octopetala	dryas	*Salix spp.*	willow
Rhamnus alnifolia	buckthorn	*Sorbus spp.*	mountain ash
Sambucus spp.	alderberry	*Amelanchier alnifolia*	serviceberry
Oplopanax horridus	devil's club	*Berberis aquifolium*	shining oregongrape
Cornus sericea	dogwood	*Pachistima myrsinites*	pachistima
Ledum glandulosum	Labrador tea	*Prunus virginiana*	chokecherry
Lonicera involucrata	black twin-berry	*Chimaphila umbellata*	prince's pine
Viburnum edule	cranberry	*Shepherida canadensis*	soap,buffaloberry
Rhododendron spp.	Rhododendron	*Betula nana*	dwarf birch
Vaccinium membranaceum	blueberry	*Cassiope tetragona*	cassiope
Vaccinium ovalifolim	blueberry	*Rosa spp.*	rose
Vaccinium myrtillus	blueberry		
	Forbs-Monocots-Ferns		
Eriophorum angustifolium	cotton grass	*Taraxacum spp.*	dandelion
Eriophorum vaginatum	cotton grass	*Erythronium grandiflorum*	glacier lily
Trifolium spp.	clover	*Lupinus nootkatensis*	lupine
Hedysarum alpinum	pink hedysarum	*Boykinia richardsonii*	Alaska boykinia
Hedysarum sulphurescens	yellow hedysarum	*Lysichitum americanum*	yellow skunk cabbage
Hedysarum mackenzii	vetch	*Oxyria digyna*	mountain sorrel
Oxytropis spp.	vetch	*Athyrium filix-femina*	lady fern
Claytonia lanceolata	spring beauty	*Mitella brewerii*	Brewer's mitrewart
Osmorhiza chilensis	mountain sweet-cicely	*Tiarella trifoliata*	trefoil foamflower
Angelica genuflexa		*Circium scariosum*	elk thistle
Angelica lucida	wild celery	*Polygonum spp.*	smartweed
Heracleum lanatum	cow parsnip	*Perideridia gairdneri*	Gairdner's yampah
Equisetum spp.	horsetail		

APPENDIX B

SUBJECT KEYWORDS, ABBREVIATIONS AND DEFINITIONS

KEYWORD	ABBREVIATION	DEFINITION
Activity Patterns	ACT PATT	Daily rhythms, diel patterns of activity and inactivity and associated behaviors.
Age Determination	AGE DETERM	Sectioning teeth, skull size, testes condition, etc. to determine age.
Age/Sex	AGE/SEX	Age/sex ratio data.
Agonistic	AGON	Intraspecific agonistic encounters; especially physical.
Agricultural Impacts	AGR IMP/MGT	Impacts and relationships to agricultural practices and associated management.
Aircraft Impacts	AIRCRAFT IMP	Disturbance due to airplanes, helicopters and associated uses.
Aversive Conditioning	AVER COND	Modifying behavior by pairing undesirable behavior with negative stimulus.
Avoidance & Attractants	AVOID/ATTRAC	How humans can avoid bear encounters (e.g., noise) or attract (e.g., odors).
Behavior Patterns	BEHAV PATT	Behavioral patterns travel and rest, usually including temporal analysis of these activities.
Bibliographies	BIBLIO	Other bibliographies containing information on grizzly bears.
Breeding Age	BRD AGE	Minimum and maximum breeding ages.
Beetle management	BTLE MGMT	Pine beetles and management.
Burn Use/Mgt	BURN USE/MGT	Use of, influence onbear distribution, and management of burn areas.
Camping management	CAMP MGMT	Backcountry and developed; including warning systems, proper garbage handling.
Cannibalism	CANNIBAL	Instances of cannibalism in grizzly bears.
Capture	CAPTURE	Techniques for trapping grizzly bears (e.g., traps, snares).
Carcass	CARCASS	Use and importance of, including scavenging one carrion.
Carrying capacity	CARR CAP	Carrying capacity of habitats and regions; theories and data.
Census methods	CENSUS METH	Methods for counting bears and assessing population size and trends (e.g. bait stations).
Census/Trend	CENSUS/TREND	Surveys (recent and historical), raw counts or trend monitoring, not population estimates.
Climate	CLIMATE	As a limiting factor (see also population regulation).
Closure	CLOSURE	Of areas, trails, etc. as a management strategy.
Control	CONTROL	Control actions: general, administrative decisions, procedures, number of bears killed, etc.
Copulation	COPULATE	Descriptions of copulations and associated behaviors.
Courtship	COURT	Breeding behavior, breeding season, pair bonds.
Cover	COVER	As in concealment, not cover types; use and importance of cover.
Cumulative effects analysis	CUM EFF	Analysis procedures; may incorporate many "impact" keywords.
Cut use	CUT USE	Use of logged areas.
Day bed	DAY BED	Use, location, and occurrence of day beds.

KEYWORD	ABBREVIATION	DEFINITION
Demographic analysis	DEMOG ANAL	Pop. trends, projections; including reproductive rates, mortality rates, age/sex, census, population estimates.
Den	DEN	Including general data on den sites characteristics and chronology, dimensions, shape, etc.
Den characteristics	DEN CHAR	Specific information on den dimensions, shape, etc.
Denning chronology	DEN CHRON	Specific information on dates of entrance, emergence, and use.
Den site	DEN SITE	Description of location, habitat, exposure around a den site.
Dentition	DENT	Tooth eruption and pattern.
Depredation	DEPRED	On livestock, property damage, "marauding" bears; may discuss associated control actions.
Deterrents & repellents	DETER/REPEL	Sprays, electric fences intended to repel grizzly bears.
Digestion	DIGEST	Information on digestion and comparison with other species.
Distribution	DISTR	Present and historical distribution.
Diurnal behavior	DIUR BEH	Behavior during the daylight hours.
Diversity	DIVERSITY	Importance of habitat diversity to grizzly bears.
Drugs	DRUGS	Types, dosages, effects and uses.
Education	EDUC	Educating people regarding bears, and associated educational materials.
Energy impacts	ENERGY IMP	Impacts from oil, gas and mining exploration and development; also pipelines and industrial developments.
Energy management	ENERGY MGMT	Oil, gas and mining management to lessen impacts.
Feeding behaviors	FEED BEH	Digging for worms, grazing and other feeding activities.
Fire management	FIRE MGMT	Management of natural fire and using fire as a management tool.
Food	FOOD	Food habit studies including scat analysis.
Foraging strategies	FOR STRAT	Theories and studies concerning foraging.
Garbage management	GARB MGMT	Management of garbage (refuse) to lessen availability to bears.
Garbage	GARBAGE	Use of, influence on behavior, movements in relation to, and impacts resulting from availability.
General biology	GEN BIOL	Including distribution, morphology, physiology, food, habitat, etc. all in general terms.
General data	GEN DATA	Including data on home range, food, habitat use, distribution, movement.
Genetics	GENETICS	Genetic makeup of grizzly bears, and influences on population biology.
Girth	GIRTH	Measurements of girth, and relation to other size measurements.
Growth & Development	GROW/DEV	Weight gains by time increment: individual size gains.
Habitat analysis	HAB ANAL	Analysis of habitat in relation to grizzly bears.
Habitat effectiveness	HAB EFFECT	Habitat ratings, suitability values; actual values; not description of types.
Habitat reconnaissance	HAB RECON	Surveys of areas for suitability as grizzly habitat, with limited observational data.
Habitat sampling	HAB SAMPL	Techniques for collecting and analyzing vegetation data, use data, etc.
Habitat use	HAB USE	Basic use data; may refer to habitat types vegetation types, component types, etc.

KEYWORD	ABBREVIATION	DEFINITION
Hair	HAIR	Micromorphology, not color patterns (see pelage).
Harvest data	HARV DATA	Numbers legally taken through hunting.
Harvest impacts	HARV IMP	Actual and theoretical impacts from harvest.
Harvest management	HARV MGMT	Setting seasons, quotas, fees, etc.
Heart	HEART	Heart-rate and effects on it from stress, drugs, etc.
Hematology	HEMAT	Blood analysis.
Hibernation physiology	HIB PHYS	Physiology as influenced by hibernation (e.g., heartrate, temperature).
Historical account	HIST ACGT	Typically narratives of historical data.
Historical	HIST DISTR	Pre-1965, both local and distribution general.
Home range	HOME RNG	Size, area, shape, theories, systems, techniques to determine home range.
Human impacts	HUMAN IMP	Miscellaneous impacts.
Human injury	HUMAN INJ	Mauling and what to do if attacked.
Identification & recog	IDENT/RECOG	Gross morphology; black vs. grizzly; chromotography, electrophoresis.
Introduction/reintro	INT/REINT	Management techniques associated with introducing, or reintroducing, grizzlies to an area.
Interspecific	INTERSP COMP	Competition with black competition bears and wolves.
Intraspecific behavior	INTRASP BEH	Hierarchies, social relationships; may include many other key words.
Legal	LEGAL	Legal and quasi-legal status; applicable statutes; administrative designations and procedures.
Length	LENGTH	Measurements of length.
Litter Frequency	LITR FREQ	Interval between litters.
Litter size	LITR SIZE	Number young/litter.
Livestock impacts	LIVESTK IMP	Competition and problems; (see also depredation).
Livestock management	LIVESTK MGMT	Avoiding depredation and conflict by active management.
Longevity	LONGEV	Numbers on age of individuals.
Mapping	MAP/TYPE	Techniques habitat/component mapping or descriptions of types mapped.
Marking	MARK	Bear trees, trails, etc.
Maternal behavior	MATERNAL	Mother/young relationships and behavior.
Measurements	MEAS/QUANT	Various size measurements.
Management, general	MGMT GEN	General statements of goals, philosophies, with some specific issues discussed.
Management plan	MGMT PLAN	For forests, parks, etc.; will include goals of management and associated keywords.
Minimum population	MIN POP	Analyses of miniumum viable population size and associated theories.
Miscellaneous	MISC QUANT	Feet, claws, muscles, etc. quantities and measurements.
Monitoring systems	MONIT SYS	For handling information on sightings, complaints, etc. (not telemetry).
Morphology & physiology	MOPH/PHYS	Descriptions and functions.
Mortality data	MORT DATA	Number dead from all causes; may include harvest, poaching, road kill, control.
Morrality management	MORT MGMT	Overall management: especially illegal kills and law enforcement.

KEYWORD	ABBREVIATION	DEFINITION
Mortality rate	MORT RATE	Mortality/survivorship analyses, usually includes support data; not just raw data.
Motorized impacts	MOTOR IMP	Motorized recreation and associated impacts.
Motorized management	MOTOR MGMT	Motorized recreation management.
Movements	MOVE	Distances, patterns of movement, daily, seasonally, year-round.
Nocturnal behavior	NOCT BEH	Behavior during night hours.
Nonmotorized impacts	NONMOTOR IMP	Nonmotorized recreation and associated impacts.
Nonmotorized management	NONMOT MGMT	Nonmotorized recreation management.
Nutrition	NUTR	Nutritional requirements.
Nutritional analyses	NUTR ANAL	Nutritional and energetic content of forage items.
Orphan	ORPHAN	Orphaned cubs, survival of, etc.
Outfitter management	OUTFIT MGMT	Management of impacts associated with outfitter activities.
Parasites & diseases	PARAS/DIS	Diseases, parasites and other natural mortality factors.
Pelage	PELAGE	Color phases, patterns of coat.
Physical chemistry	PHYS CHEM	Physical chemistry, except for hematology.
Poaching & illegal mort.	POACH/ILLEG	Significance of and degree of all illegal kills, includes raw data.
Poisoning	POISON	Direct or indirect impacts of poison.
Political & admin. mgmt.	POL/ADM MGMT	Administrative strategies, coordination.
Population augmentation	POP AUG	Rationale, methods of augmenting populations.
Population biology	POP BIOL	Data on age/sex, longevity, mortality and reproductive rates, etc.
Population density	POP DENS	Number per unit area; regionally or population wide.
Population estimate	POP EST	Often included in demographic analysis.
Population regulation	POP REG	Controlling factors, including compensatory factors, nutrition and other regulators.
Predation	PRED	Accounts, degree, importance of predation; includes predation on ungulates, rodents and fish.
Present distribution	PRES DISTR	Post-1965, both local and region wide.
Public attitudes	PUBLIC ATT	Questionnaires, surveys of public attitude.
Reaction	REACTION	Reaction of bears to human encounters, includes habituation.
Recreational impacts	RECR IMP	General, including both motorized and nonmotorized activities; also recreational developments.
Recreational management	RECR MGMT	General, includes both motorized and nonmotorized activities.
Relocation	RELOC	Relocation of problem bears.
Reproductive rate	REP RATE	General and population specific; includes breeding age, litter size, litter frequency.
Reproduction	REPRO	Includes reproductive physiology, behavior, litter size, strategies and other reproduction topics.
Reproductive physiology	REPRO PHYS	Includes morphology and physiology.
Research mortality	RES MORT	Overdoses and other research-related mortality and injury.
Research techniques	RES TECH	General research techniques.
Road impacts	ROAD IMP	Impacts of construction and use on habitat and bears.

KEYWORD	ABBREVIATION	DEFINITION
Road management	ROAD MGMT	Use times, closures, construction, design.
Road mortality	ROAD MORT	Bear mortality associated with roads.
Scat analysis	SCAT ANAL	Techniques of scat analysis.
Seasonal behavior	SEAS BEH	Variation in behavior by season, may discuss movements, habitat use, distribution.
Sensory	SENSE	General discussion of senses.
Sibling behavior	SIB BEH	Behavior of litter mates, and related young.
Sight	SIGHT	Sight capabilities.
Skull	SKULL	Skull descriptions, measurements and use in aging and sexing.
Smell	SMELL	Olfactory capabilities.
Subdivision management	SUBDIV MGMT	Management of developments and associated impacts.
Supplemental feeding	SUPPL FEED	Techniques for providing supplemental food sources.
Taxonomy/evolution	TAXON/EVOL	Taxonomy and evolution of bear species.
Telemetry	TELEM	Systems and equipment and uses of telemetry.
Temperature	TEMP	Internal temperatures.
Temporary baiting	TEMP BAIT	Providing baits for trapping and censusing.
Territoriality & spacing	TERR/SPACE	Includes concentrations, territorial defense.
Threat	THREAT	Threat displays and behavior, especially intraspecific.
Timber impacts	TIMB IMP	Impacts of logging and associated impacts.
Timber management	TIMB MGMT	Management of logging and associated impacts.
Timber use	TIMB USE	Importance of timber to grizzlies.
Timber (mgmt by) entrance	TIMB-ENTRY	Harvest management temporally.
Timber (mgmt by) habitat	TIMB-HAB	Timber management by habitat.
Timber (harvest) method	TIMB-METH	Methods of timber harvest and impacts.
Timber (mgmt) post harvest	TIMB-POST	Post harvest management for grizzlies.
Type descriptions	TYPE DESCRIP	Descriptions of vegetation components, or habitat types (not mapping).
Ungulate competition	UNG COMP	Indirect competition with relationships to, ungulates.
Urban development	URBAN DEV	Impacts of urban development.
Vegetative succession	VEG SUCC	Use of areas, described by vegetative succession.
Vocalizations	VOCAL	Vocalizations and associated behaviors.
Weaning	WEAN	Timing, behavior; actual weaning (end of lactation) and family breakup.
Weight	WEIGHT	Weight data.
Zoning	ZONING	Delineation of critical habitat, management zones, etc.
Zoo techniques	ZOO TECH	Captive rearing, housing, special procedures, reviews of measurements.

APPENDIX C

GEOGRAPHIC DESCRIPTORS AND ABBREVIATIONS

STATE

ABBREVIATION	DESCRIPTION	ABBREVIATION	DESCRIPTION
ABC	Alaska & British Columbia	ID	Idaho
ABM	Alberta, British Columbia & Montana	IDMT	Idaho & Montana
AK	Alaska	IDWA	Idaho & Washington
AT	Alberta	IDWY	Idaho & Wyoming
ATBC	Alberta & British Columbia	IMW	Idaho, Montana & Wyoming
ATMT	Alberta & Montana	MEX	Mexico
ATSA	Alberta & Saskatchewan	MNTB	Manitoba
AZNM	Arizona & New Mexico	MT	Montana
BC	British Columbia	MTWY	Montana & Wyoming
BCIW	British Columbia, Idaho & Washington	NM	New Mexico
BCMT	British Columbia & Montana	NWT	Northwest Territories
BCWA	British Columbia & Washington	NWYK	Northwest Territories & Yukon Territory
BIM	British Columbia, Idaho & Montana	ONT	Ontario
CA	California	SK	Saskatchewan
CAN	Canada (general)	SWMX	Southwestern United States & Mexico
CAUS	Canada/United States border areas	US	United States (general)
CO	Colorado	WA	Washington
ECAN	Eastern Canada (Lab, Que, Nova & Newf)	WY	Wyoming
GEN	General	YK	Yukon Territory

ECOSYSTEM

ABBREVIATION	DESCRIPTION	ABBREVIATION	DESCRIPTION
AK-I	Alaska Interior: mainland	CR	Canadian Rockies
AKKA	Alaska: Kodiak and Afognak Islands	CYE	Cabinet-Yaak Ecosystem (KONF, IPNF & LONF)
AKPN	Alaska: main peninsula and Kenai Peninsula	CYNC	Cabinet-Yaak and Northern Cont. Divide Ecosystems
AKSE	Alaska: southeast	NCDE	Northern Continental Divide Ecosystem
ARC	Arctic Alaska	NCE	North Cascades Ecosystem
BC-C	Coastal British Columbia	NINT	Northern Interior (BC & YK)
BC-I	Interior British Columbia	SBE	Selway-Bitterroot Ecosystem
BORF	Boreal Forest	SME	Selkirk Mountains Ecosystem
CARC	Canadian Arctic	YGBE	Yellowstone Ecosystem

ADMINISTRATIVE UNIT

ABBREVIATION	DESCRIPTION	ABBREVIATION	DESCRIPTION
AINM	Admiralty Island National Monument (SE AK)	KGPP, KGNP	Kokanee-Glacier Provincial Park (BC)
ANWR	Arctic National Wildlife Refuge (N AK)	KLGS	Kluane Game Sanctuary (YK)
ATPP	Alberta Provincial Parks	KNWR	Kodiak National Wildlife Refuge (S AK)
BANP	Banff National Park (AT)	KONF	Kootenai National Forest (MT)
BINF	Bitterroot National Forest (ID & MT)	LCNF	Lewis and Clark National Forest (MT)
BLIR	Blackfeet Indian Reservation (MT)	LONF	Lolo National Forest (MT)
BLM	Bureau of Land Management	MCGS	McNeil River Game Sanctuary (AK)
BTNF	Bridger-Teton National Forest (WY)	NCNP	North Cascades National Park (WA)
CGNP	Canadian Glacier National Park (BC)	NPNF	Nez Perce National Forest (ID)
CLNF	Clearwater National Forest (ID)	NPR	National Petroleum Reserve (Arctic AK)
DENP	Denali National Park (central AK)	NPS	National Park Service
FLIR	Flathead Indian Reservation (MT)	PC	Parks Canada
FLNF	Flathead National Forest (MT)	RGNF	Rio Grande National Forest (CO)
GANF	Gallatin National Forest (MT)	SHNF	Shoshone National Forest (WY)
GINF	Gila National Forest (NM)	SJNF	San Juan National Forest (CO)
GLNP	Glacier National Park (MT)	SPPP	Spatsizi Provincial Park (BC)
GTNP	Grand Teton National Park (WY)	SRGR	Sun River Game Range (MT)
IPNF	Idaho Panhandle National Forest	TANF	Targhee National Forest (ID & WY)
JANP	Jasper National Park (AT)	THGS	Thelon Game Sanctuary (NWT)
JDR	John D. Rockefeller Memorial Parkway (WY)	TONF	Tongass National Forest (AK)
		USFS	United States Forest Service
KANM	Katmai National Monument (penin AK)	VAPP	Valhalla Provincial Park (BC)
KANP	Kananaskis Provincial Park (AT)	WANP	Waterton Lakes National Park (AT)
		YNP	Yellowstone National Park (WY)

LOCALE

ABBREVIATION	DESCRIPTION
ADIS	Admiralty Island (AK)
AHNU	Ahnuhati Watershed (BC-I)
AKKI	Akamina-Kishinena Creek drainage (NFLT, ABM)
AKRG	Alaska Range (southcentral AK-I)
AKSC	Susitna (southcentral AK-I)
ALSE	Alsek River (YK)
AMER	American River (AKPN)
ANBU	Antelope Butte (NCDE, MT)
APGR	Apgar Mountains (GLNP, MT)
ASHT	Ashton Ranger District (TANF, IDWY)
BACR	Badger Creek/Medicine Two area (LCNF, MT)
BARN	Barn Mountains (CARC, YK)
BLKL	Black Lake (AKPN)
BMWA	Bob Marshall Wilderness Area (MT)
BRKR	Brooks Range (AK-I)
BROO	Brooks Camp (KANM, AK)
CAB	Cabinet Mountains (MT)
CAMA	Camas Creek (GLNP, MT)
CASC	Cascade Valley (BANP, AT)
CENT	Centennial Mountains (MT)
CHIG	Chignak Lake (AKPN)
CLAR	Clark Fork Hydro Projects (MT)
CLCR	Clear Creek (YNP, WY)
COPR	Copper River Delta (southern AK-I)
CUWI	Cuthead-Wigmore area (BANP, AT)
CYPR	Cypress Hills (AT & SK)
EBRK	Eastern Brooks Range (AK-I)
ELLK	Elizabeth Lake (GLNP, MT)
FISH	Fishing Bridge (YNP, WY)
GALL	Gallatin Range (MT)
GIWA	Gila Wilderness Area (NM)
HAYD	Hayden Valley (YNP, WY)
HUNG	Hungry Horse Reservoir (MT)
ISLP	Island Park (GLNP, MT)
JARD	Jardine (YGBE)
JIML	Jim Lakes (AK-1)
KANA	Kananaskis Country (AT)
KARL	Karluk Lake (KNWR, AK)
KENA	Kenai Peninsula (AKPN)
KIMS	Kimsquit Valley (BC-C)
KOIS	Kodiak Island (AKKA)
KOOC	Lake Koocanusa (between NCDE & CYE, MT)
LAKE	Yellowstone Lake (YNP, WY)
LOUI	Lake Louise (BANP, AT)
LSWA	Lincoln-Scapegoat Wildlife area (MT)
MADR	Madison Range (MT)
MANY	Many Glacier (GLNP, MT)
MCNE	McNeil River (by Kamishak Bay, AKPN)
MCPK	McDonald Peak (MT)
MISS	Mission Valley/Mountains (FLNF & FLIR, MT)
MMTN	Mackenzie Mountains (NINT, NWT)
NAKR	Nakina River (BC-C)
NESU	Nelchina Basin (AK-I)
NFLT	North Fork Flathead River (MT)
NSLP	North Slope (northern AK-1)
OMIN	Omineca Region (eastern BC-I)
PACR	Pack Creek area (AKSE)
PELI	Pelican Valley (YNP, WY)
PIBU	Pine Butte (RMEF, MT)
PRWM	Prince William Sound (south AK)
RATT	Rattlesnake Wildlife Area (NCDE & LONF, MT)
REVL	Revelstoke (CR, BC)
RICH	Richards Island (by TUKP, NWT)
RMEF	Rocky Mountain East Front (MT)
SBWA	Selway-Bitterroot Wilderness Area (IDMT)
SCAP	Scapegoat Wilderness Area (NCDE)
SEEL	Seeley Lake area (MT)
SFLT	South Fork Flathead River (MT)
SIMP	Fort Simpson (NWT)
SJMT	San Juan Mountains (CO)
SKEE	Skeena Region (BC-I)
SKYL	Ski Yellowstone (MT)
SLCK	Sullivan Creek (MT)
STEE	Steese-Taylor Highway (AK/YK border)
STMR	St. Mary's (GLNP, MT)
SUNR	Sun River (MT)
SWAN	Swan-Clearwater area (MT)
SWAP	South Wapiti area (S. Grand Prairie, AT)
SWHI	Swan Hills (AT)
TERL	Terror Lake area (AKKA)
TEWI	Teton Wilderness (WY)
TROU	Trout Creek (YNP, WY)
TUKP	Tuktoyaktuk Peninsula (NWT)
TWOM	Two Medicine drainage (GLNP, MT)
WBRK	Western Brooks Range (northern AK-I)
WGLA	West Glacier (MT)
WHIL	White Lake (YNP, WY)
WHR	Whitefish Range (KONF & FLNF, MT)
YAKR	Yaak River drainage (CYE, MT)
YUKR	Yukon River (AK-I & YK)

APPENDIX D

CITATION INDEX (WITH SUBJECT AND GEOGRAPHIC KEYWORDS)

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EDUC MONIT SYS CONTROL

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CUT USE

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DEN	DAY BED	PRES DISTR	HAB RECON

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HAB EFFECT	ROAD IMP		GEN DATA

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HIST DISTR	DEPRED	POP EST	FOOD

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CYE ,IDMT, , ,

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NONMOT MGMT

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MGMT GEN	TIMB IMP	COVER	
CENSUS/TREND	DEMOG ANAL	MORT DATA	MOVE

BC-C,BC , , ,

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WILDLIFE WORKING REP. NO. WR-17, WILDLIFE HABITAT RESEARCH REPORT NO. WHR-22, MINISTRY OF ENV. AND MINISTRY OF FORESTS, VICTORIA, B.C. 62 PP.

DAY BED	FOOD	MARK	PRED
COVER	HOME RNG	TIMB IMP	ROAD IMP

BC-C,BC , , ,KIMS

00029

ARCHIBALD, W.R., M. SONDHEIM AND A.N. HAMILTON.

1984
COMPUTERIZED MAPS AS AN AID TO GRIZZLY BEAR HABITAT DEFINITION.

PP. 215-223 IN: WEST. PROC. 64TH ANNU. CONF. OF THE WEST. ASSOC. OF FISH AND WILDL. AGENCIES, 16-19 JULY 1984, VICTORIA, B.C.

MAP/TYPE

BC-C,BC , , ,

00030

ARNOLD, B.

1930
CANNIBAL BEAR.

YELLOWSTONE NAT. NOTES 7(8):54.

INTERSP COMP

YGBE,IMW ,YNP , ,

00031

ASHLEY, K.

1976
FINDINGS OF BOARD OF INQUIRY REGARDING DEATH OF MARY PATRICIA MAH ONEY, GLACIER NATIONAL PARK, SEPTEMBER 23, 1976.

U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. BOARD OF IN QUIRY REP. 7 PP.

HUMAN INJ RECR MGMT

NCDE,MT ,GLNP, ,MANY

00032

ASHLEY, K.R., D. GILHAM, D. HARMS, S. HERRERO, F. NEWBY AND C. MENE FEE.
1980
FATAL GRIZZLY BEAR MAULING OF KIM EBERLY AND JANE AMMERMAN, JULY 24, 1980.

U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. BOARD OF RE VIEW REP. 10 PP.

HUMAN INJ RECR MGMT

NCDE,MT ,GLNP,BLIR,STMR

00033

ASHLEY, K.R., F. NEWBY, D. HARMS, T. BULL, W. SALOIS AND C. MENEFEE
.
1981
PROBABLE FATAL GRIZZLY BEAR MAULING OF LAWRENCE BYRON GORDON, SEP
TEMBER 26 OR 27, 1980.

U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. BOARD OF RE
VIEW REP. 8 PP.

HUMAN INJ RECR MGMT

NCDE,MT ,GLNP, ,ELLK

00034

ATWELL, G., D.L. BOONE, J. GUSTAFSON AND V.D. BERNS.

1980
BROWN BEAR SUMMER USE OF ALPINE HABITAT ON THE KODIAK NATIONAL WI
LDLIFE REFUGE.

INT. CONF. BEAR RES. AND MANAGE. 4:297-305.

HAB USE TERR/SPACE MOVE FOOD

AKKA,AK ,KNWR, ,KOIS

00035

AUNE, K.

1985
ROCKY MOUNTAIN FRONT GRIZZLY BEAR MONITORING AND INVESTIGATION.

MONT. DEP. FISH, GAME AND WILDL., HELENA. 139 PP.

MAP/TYPE POP BIOL GEN DATA MEAS/QUANT
DEN PRES DISTR MORT DATA LIVESTK IMP
ENERGY IMP
NCDE,MT ,USFS,BLM ,RMEF

00036

AUNE, K., M. MADEL AND C. HUNT.

1986
ROCKY MOUNTAIN FRONT GRIZZLY BEAR MONITORING AND INVESTIGATION.

MONT. DEP. FISH, WILDL. AND PARKS, HELENA. 175PP.

POP BIOL HOME RNG ENERGY IMP ROAD IMP
PRES DISTR DEN HAB EFFECT MAP/TYPE
MGMT GEN
NCDE,MT ,USFS,BLM ,RMEF

00037

AUNE, K. AND T. STIVERS.

1981
ROCKY MOUNTAIN FRONT GRIZZLY BEAR MONITORING AND INVESTIGATION.

MONT. DEP. FISH, WILDL. AND PARKS, HELENA. 68 PP.

DEPRED	DEN	MAP/TYPE	RELOC
MEAS/QUANT	CLIMATE	GEN DATA	

NCDE,MT ,USFS,BLM ,RMEF

00038

AUNE, K. AND T. STIVERS.

1982
ROCKY MOUNTAIN FRONT GRIZZLY BEAR MONITORING AND INVESTIGATION.

MONT. DEP. FISH, WILDL. AND PARKS, HELENA. 143 PP.

GEN DATA	POP BIOL	ENERGY IMP	ENERGY MGMT
LIVESTK MGMT	ACT PATT	DEN	HAB USE

NCDE,MT ,USFS,BLM ,RMEF

00039

AUNE, K. AND T. STIVERS.

1983
ROCKY MOUNTAIN FRONT GRIZZLY BEAR MONITORING AND INVESTIGATION.

MONT. DEP. FISH, WILDL. AND PARKS, HELENA. 180 PP.

GEN DATA	ACT PATT	DEN	HAB USE
POP BIOL	ENERGY IMP	ROAD IMP	LIVESTK IMP

NCDE,MT ,USFS,BLM ,RMEF

00040

AUNE, K. AND T. STIVERS.

1985
ECOLOGICAL STUDIES OF THE GRIZZLY BEAR IN THE PINE BUTTE PRESERVE

MONT. DEP. FISH, WILDL. AND PARKS, HELENA. 154 PP.

GEN DATA	ACT PATT	DEN	HAB USE
LIVESTK IMP	ROAD IMP	POP BIOL	

NCDE,MT ,USFS,BLM ,RMEF

00041

AUNE, K., T. STIVERS AND M. MADEL.

1984
ROCKY MOUNTAIN FRONT GRIZZLY BEAR MONITORING AND INVESTIGATION.

MONT. DEP. FISH, WILDL. AND PARKS, HELENA. 239 PP.

GEN DATA	ACT PATT	DEN	ENERGY IMP
ROAD IMP	LIVESTK IMP	HAB EFFECT	POP BIOL

NCDE,MT ,USFS,BLM ,RMEF

00042

AVRIN, D.E.

1976
A NUMERICAL MODEL OF THE YELLOWSTONE GRIZZLY BEAR POPULATION AND ITS MANAGEMENT IMPLICATIONS.

M.S. THESIS., UNIV. MICH., ANN ARBOR. 51 PP.

DEMOG ANAL	POP REG	REP RATE	AGE/SEX
MORT RATE			

YGBE,IMW , , ,

00043

AZIZI, F., J.E. MANNIX, D. HOWARD AND R.A. NELSON.

1979
EFFECT OF WINTER SLEEP ON PITUITARY-THYROID AXIS IN AMERICAN BLAC K BEAR.

AM. J. PHYSIOL. 237(3):E227-E230.

HEMAT	HIB PHYS

,GEN , , ,

00044

BAGGLEY, G.F.

1936
STATUS AND DISTRIBUTION OF THE GRIZZLY BEAR (URSUS HORRIBILIS) IN THE UNITED STATES.

TRANS. NORTH AM. WILDL. CONF. 1:646-650.

HIST DISTR	CENSUS/TREND

,GEN , , ,

00045

BAILEY, E.P. AND N.H. FAUST.

1984
DISTRIBUTION AND ABUNDANCE OF MARINE BIRDS BREEDING BETWEEN AMBER AND KAMISHAK BAYS, ALASKA, WITH NOTES ON INTERACTIONS WITH BEARS

WEST. BIRDS 15:161-174.

PRED

AKPN,AK , , ,

00046

BAILEY, V.

1932
MAMMALS OF NEW MEXICO.

U.S.D.A., BUR. OF BIOLOGICAL SURVEY. NORTH AM. FAUNA NO. 53. GOV. PRINTING OFF., WASHINGTON, D.C.

HIST DISTR HIST ACCT

,AZNM, , ,

00047

BALDWIN, S.B., B.R. BUTTERFIELD, R.G. WRIGHT AND G.E. MACHLIS.

1985
HABITAT AND VISITOR MAPPING IN THE TWO MEDICINE AREA OF GLACIER NATIONAL PARKS: COMBINING INFORMATION-GATHERING TECHNIQUES.

IDAHO COOP. PARK STUDIES UNIT, UNIV. IDAHO, MOSCOW. 110 PP.

MAP/TYPE HAB EFFECT MOTOR MGMT NONMOT MGMT

NCDE,MT ,GLNP, ,TWOM

00048

BALL, R.E.

1976
THE USE OF TIME-LAPSE CAMERAS IN DISTRIBUTION AND POPULATION STUDIES OF GRIZZLY BEARS (URSUS ARCTOS) IN THE SHOSHONE NATIONAL FOREST, PARK COUNTY, WYOMING.

M.S. THESIS, UNIV. WYO., LARAMIE. 34 PP.

CENSUS METH

YGBE,WY ,SHNF, ,

00049

BALL, R.E.

1980
TIME-LAPSE CAMERAS AS AN AID IN STUDYING GRIZZLY BEARS IN NORTHWE
ST WYOMING.

INT. CONF. BEAR RES. AND MANAGE. 4:331-335.

CENSUS METH

YGBE,WY ,SHNF,

00050

BALLARD, W.B.

1980
BROWN BEAR KILLS GRAY WOLF.

CAN. FIELD-NAT. 94(1):91.

PRED INTERSP COMP

AKSC,AK , , ,NESU

00051

BALLARD, W.B.

1981A
GRAY WOLF - BROWN BEAR RELATIONSHIPS IN THE NELCHINA BASIN OF SOU
THCENTRAL ALASKA.

APPENDIX III. PP. 182-196 IN: W.B. BALLARD ET AL. NELCHINA BASIN
WOLF STUDIES. FED. AID WILDL. REST. PROJ. W-17-8, W-17-9, W-17-10
AND W-17-11, JOBS 14.8R, 14.9R AND 14.10R. ALASKA DEP. FISH AND
GAME, JUNEAU.

PRED INTERSP COMP

AKSC,AK , , ,NESU

00052

BALLARD, W.B.

1982
GRAY WOLF - BROWN BEAR RELATIONSHIPS IN THE NELCHINA BASIN OF SOU
TH-CENTRAL ALASKA.

PP. 71-80 IN: F.H. HARRINGTON AND P.C. PAQUET, EDS. WOLVES OF THE
WORLD. NOYES PUBL., PACK RIDGE, N.J.

INTERSP COMP PRED CARCASS

AKSC,AK , , ,NESU

00053

BALLARD, W.B., A.W. FRANZMANN, K.P. TAYLOR, T.H. SPRAKER, C.C. SCHW
ARZ AND R.O. PETERSON.
1980A
COMPARISON OF TECHNIQUES UTILIZED TC DETERMINE MOOSE CALF MORTALI
TY IN ALASKA.

APPENDIX I. PP. 22-39 IN: W.B. BALLARD ET.AL. NELCHINA MOOSE CALF
 MORTALITY STUDIES. FED. AID WILDL. REST. PROJ. W-17-9, W-17-10,
W-17-11 AND W-21-1, JOB 1.23R. ALASKA DEP. FISH AND GAME, JUNEAU.

PRED

AKSC,AK , , ,NESU

00054

BALLARD, W.B., C.L. GARDNER, S. EIDE AND R. TCBEY.

1980B
NELCHINA YEARLING MOOSE MORTALITY STUDY.

FED. AID WILDL. REST. PROJ. W-21-11 AND W-21-1, JOB 1.2R. PROG. R
EP. ALASKA DEP. FISH AND GAME, JUNEAU. 22 PP.

PRED

AKSC,AK , , ,NESU

00055

BALLARD, W.B., C.L. GARDNER AND S.D. MILLER.

1982A
NELCHINA YEARLING MOOSE MORTALITY STUDY.

FED. AID WILDL. REST. PROJ. W-21-1 AND W-21-2, JOB 1.27R. FINAL R
EP., VOL. II. ALASKA DEP. FISH AND GAME, JUNEAU. 24 PP.

PRED CONTROL

AKSC,AK , , ,NESU

00056

BALLARD, W.B., S.D. MILLER AND T.H. SPRAKER.

1982B
HOME RANGE, DAILY MOVEMENTS, AND REPRODUCTIVE BIOLOGY OF BROWN BE
AR IN SOUTHCENTRAL ALASKA.

CAN. FIELD-NAT. 96(1):1-5.

HOME RNG MOVE DEN CHRON BRD AGE
LITR FREQ LITR SIZE COURT

AKSC,AK , , ,NESU

00057

BALLARD, W.B., S.D. MILLER, T.H. SPRAKER, K.P. TAYLOR AND S.H. EIDE
.
1980C
BIG GAME INVESTIGATIONS, NELCHINA MOOSE CALF MORTALITY STUDY.

FED. AID WILDL. REST. PROJ. W-17-9, W-17-10, W-17-11 AND W-21-1, JOB 1.23R. FINAL REP., APR. 1, 1977-JUNE 30, 1980. ALASKA DEP. FI SH AND GAME, JUNEAU. 123 PP.

PRED CONTROL RELOC POP EST
HEMAT MEAS/QUANT HOME RNG AGE/SEX
MOVE
AKSC,AK , , ,NESU

00058

BALLARD, W.B. AND T. SPRAKER.

1979
UNIT 13 WOLF STUDIES.

FED. AID WILDL. REST. PROJ. W-17-9 AND W-17-10, JOBS 14.3R, 14.9R AND 14.10R. PROJ. PROG. REP., VOL. II. ALASKA DEP. FISH AND GAME , JUNEAU. 83 PP.

INTERSP COMP PRED

AKSC,AK , , ,NESU

00059

BALLARD, W.B., T.H. SPRAKER AND K.P. TAYLOR.

1981A
CAUSES OF NEONATAL MOOSE CALF MORTALITY IN SOUTH CENTRAL ALASKA.

J. WILDL. MANAGE. 45(2):335-342.

PRED

ARC ,AK , , ,NESU

00060

BALLARD, W.B., R.O. STEPHENSON AND T.H. SPRAKER.

1981B
NELCHINA BASIN WOLF STUDIES.

FED. AID WILDL. REST. PROJ. W-17-8, W-17-9, W-17-10 AND W-17-11, JOBS 14.8R, 14.9R AND 14.10R. FINAL REP. ALASKA DEP. FISH AND GAM E, JUNEAU. 204 PP.

PRED INTERSP COMP

AKSC,AK , , ,NESU

00061

BALLARD, W.B. AND K.P. TAYLOR.

1978B
MOOSE CALF MORTALITY STUDY, GAME MANAGEMENT UNIT 13.

FED. AID WILDL. REST. PROJ. W-17-9 (2ND HALF) AND W-17-10 (1ST HA
LF), JOB 1.23. PROJ. PROG. REP., VOL. I. ALASKA DEP. FISH AND GAM
E, JUNEAU. 43 PP.

PRED

AKSC,AK , , ,NESU

00062

BANFIELD, A.W.F.

1958
DISTRIBUTION OF THE BARREN-GROUND GRIZZLY BEAR IN NORTHERN CANADA
.

NATL. MUS. CAN. BULL. NO. 166:47-59.

HIST DISTR HIST ACCT

,NWT , , ,

00063

BANNER, A., J. POJAR, R. TROWBRIDGE AND A. HAMILTON.

1986
GRIZZLY BEAR HABITAT IN THE KIMSQUIT RIVER VALLEY, COASTAL BRITIS
H COLUMBIA: CLASSIFICATION, DESCRIPTION, AND MAPPING.

PP. 36-49 IN G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZ
ZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN
RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

MAP/TYPE TYPE DESCRIP

BC-C,BC , , ,KIMS

00064

BARNES, R. AND C. JONKEL.

1977
WILDFIRE IN THE DEVELOPMENT AND MAINTENANCE OF GRIZZLY BEAR HABIT
AT.

PP. 12-22 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ.,
UNIV. MONT., MISSOULA. ANNU. REP. NO. 2.

FIRE MGMT

NCDE,MT ,FLNF, ,

00065

BARNES, V.G., JR.

1984
BROWN BEAR STUDIES.

U.S.D.I., FISH AND WILDL. SERV., DENVER WILDL. RES. CENT., ALASKA WILDL. RES. PROJ., PROG. REP. 28 PP.

AGE/SEX	LITR SIZE	MORT RATE	HOME RNG
DEN CHRON	DEN SITE	CENSUS METH	HAB USE
MOVE			

AKKA,AK ,KNWR, ,

00066

BARNES, V.G., JR.

1985
BROWN BEAR STUDIES - 1984.

U.S.D.I., FISH AND WILDL. SERV., DENVER WILDL. RES. CENT., ALASKA WILDL. RES. PROJ., PROG. REP. 38 PP.

AGE/SEX	WEAN	LITR SIZE	MORT RATE
HOME RNG	MOVE	HAB USE	CENSUS/TREND

AKKA,AK ,KNWR, ,

00067

BARNES, V.G., JR., R.M. ANTHONY, K.A. FAGERSTONE AND J. EVANS.

1985
HAZARDS TO GRIZZLY BEARS TO STRYCHNINE BAITING FOR POCKET GOPHER CONTROL.

WILDL. SOC. BULL. 13:552-558.

POISON

,GEN , , ,

00068

BARNES, V.G., JR. AND O.E. BRAY.

1967
POPULATION CHARACTERISTICS AND ACTIVITIES OF BLACK BEARS IN YELLO WSTONE NATIONAL PARK.

COLORADO COOP. WILDL. RES. UNIT, COLORADO STATE UNIV. 199 PP.

INTERSP COMP	CENSUS METH	INTRASP BEH

YGBE,IMW ,YNP , ,

00069

BASILE, J.V.

1982
GRIZZLY BEAR DISTRIBUTION IN THE YELLOWSTONE AREA, 1973-79.

U.S.D.A., FOREST SERV., INTERMOUNTAIN FOR. AND RANGE EXPT. STAT., OGDEN, UTAH. RES. NOTE NO. INT-321. 11 PP.

PRES DISTR

YGBE,IMW ,YNP ,USFS,

00070

BEATTIE, J.B.

1983
BROWN BEAR/HUMAN INTERACTIONS AT KATMAI NATIONAL PARK AND PRESERV E: IMPLICATIONS FOR PLANNING AND MANAGEMENT.

B.A. THESIS (SENIOR), UNIV. CALIF., SANTA CRUZ. 32 PP.

RECR IMP REACTION RECR MGMT

AKPN,AK ,KANM, ,BROO

00071

BEATY, D.

1979A
TELEMETRY QUESTIONS AND ANSWERS.

PROC. WEST. BLACK BEAR WORKSHOP 1:137-166.

TELEM

,GEN , , ,

00072

BEATY, D.W.

1979B
ANTENNA CONSIDERATIONS FOR BIOMEDICAL TELEMETRY.

PROC. WEST. BLACK BEAR WORKSHOP 1:267-281.

TELEM

,GEN , , ,

00073

BEECHAM, J.J.

1980
POPULATION CHARACTERISTICS, DENNING, AND GROWTH PATTERNS OF BLACK BEARS IN IDAHO.

PH.D. DISS., UNIV. MONTANA, MISSOULA. 95 PP.

CENSUS METH POP REG

,GEN , , ,

00074

BEMRICH, W.J. AND T.P. O'LEARY.

1979
A COCCIDIAN FROM A GRIZZLY BEAR.

VET. MED. SMALL ANIM. CLIN. 74(3):389-390.

PARAS/DIS

,GEN , , ,

00075

BEN SHAUL, D.M.

1962
NOTES ON HAND-REARING VARIOUS SPECIES OF MAMMALS.

INT. ZOO YEARB. 4:300-342.

GROW/DEV ZOO TECH

,GEN , , ,

00076

BERGERUD, A.T., H.E. BUTLER AND D.R. MILLER.

1984
ANTIPREDATOR TACTICS OF CALVING CARIBOU: DISPERSION IN MOUNTAINS.

CAN. J. ZOOL. 62:1566-1575.

PRED

BC-I,BC ,SPPP, ,

00077

BERNS, V.D., G.C. ATWELL AND D.L. BOONE.

1980
BROWN BEAR MOVEMENTS AND HABITAT USE AT KARLUK LAKE, KODIAK ISLAN
D.

INT. CONF. BEAR RES. AND MANAGE. 4:293-296.

DEN CHRON MOVE

AKKA,AK ,KNWR, ,KARL

00078

BERNS, V.D. AND R.J. HENSEL.

1972
RADIO TRACKING BROWN BEARS ON KODIAK ISLAND.

INT. CONF. BEAR RES. AND MANAGE. 2:19-25.

HOME RNG MOVE HAB USE

AKKA,AK ,KNWR, ,

00079

BEVINS, J.S., C.C. SCHWARTZ, E.E. BANGS AND K.J. NELSON.

1985
KENAI PENINSULA BROWN BEAR STUDIES: REPORT OF THE INTERAGENCY BRO
WN BEAR STUDY TEAM, 1984.

ALASKA DEP. FISH AND GAME, MISC. PUBL. 103PP.

PRED PRES DISTR CENSUS/TREND HAB RECON
HARV DATA MGMT PLAN FOOD

AKPN,AK , , ,KENA

00080

BIELANSKA-OSUCHOWSKA, Z. AND S. SZANKOWSKA.

1970
HISTOLOGICAL AND HISTOCHEMICAL STUDIES ON THE ALIMENTARY TRACT IN
THE BROWN BEAR.

ACTA THERIOL. 15(13-23):303-342.

MORPH/PHYS DIGEST

,GEN , , ,

00081

BISSELL, S.

1978
ESSENTIAL HABITAT FOR THREATENED OR ENDANGERED WILDLIFE IN COLORA
DO, PART III - MAMMALS.

COLO. DIV. WILDL., DENVER.

PRES DISTR LEGAL

,CO , , ,

00082

BJORKLUND, J.

1978
PRELIMINARY INVESTIGATION OF THE FEASIBILITY OF REESTABLISHING A
GRIZZLY BEAR POPULATION IN THE NORTH CASCADES NATIONAL PARK COMPL
EX.

U.S.D.I., NATL. PARK SERV., NORTH. CASCADES NATL. PARKS, WASH. MI
SC. RES. PAPER NCT-8. 35 PP.

INT/REINT DISTR PCP EST
HAB RECON

NCE ,WA ,NCNP, ,

00083

BJORKLUND, J.

1980A
HABITAT AND VEGETATIVE CHARACTERISTICS OF A REMOTE BACKCOUNTRY AR
EA AS RELATED TO REESTABLISHMENT OF A GRIZZLY POPULATION IN THE N
ORTH CASCADES NATIONAL PARK COMPLEX.

U.S.D.I., NATL. PARK SERV., NORTH. CASCADES NATL. PARKS, WASH. MI
SC. RES. PAPER NCT-10. 38 PP.

INT/REINT HAB RECON

NCE ,WA ,NCNP, ,

00084

BJORKLUND, J.

1980B
HISTORICAL AND RECENT GRIZZLY BEAR SIGHTINGS IN THE NORTH CASCADE
S.

U.S.D.I., NATL. PARK SERV., NORTH. CASCADES NATL. PARKS, WASH. MI
SC. RES. PAPER NCT-13. 10PP.

HIST DISTR PRES DISTR HIST ACCT

NCE ,WA ,NCNP,USFS,

00085

BLANCHARD, B.

1978
GRIZZLY BEAR DISTRIBUTION IN RELATION TO HABITAT AREAS AND RECREA
TIONAL USE: CABIN CREEK - HILGARD MOUNTAINS.

M.S. THESIS, MONT. STATE UNIV., BOZEMAN. 75 PP.

PRES DISTR	HAB USE	RECR IMP	PUBLIC ATT
REACTION	BEHAV PATT	FOOD	TIMB USE

YGBE,MT ,GANF, ,MADR

00086

BLANCHARD, B.

1983
GRIZZLY BEAR-HABITAT RELATIONSHIPS IN THE YELLOWSTONE AREA.

INT. CONF. BEAR RES. AND MANAGE. 5:118-123.

HAB USE	TIMB USE	FOOD	FEED BEH
COVER	DAY BED	CARCASS	DIVERSITY
TIMB-METH			

YGBE,IMW , , ,

00087

BLANCHARD, B.M.

IN PRESS
SIZE AND GROWTH PATTERNS OF THE YELLOWSTONE GRIZZLY.

INT. CONF. BEAR RES. AND MANAGE.

WEIGHT	GROW/DEV	LENGTH	GIRTH
FOOD	GARBAGE	MISC QUANT	

YGBE,IMW , , ,

00088

BLANCHARD, B.M. AND R.R. KNIGHT.

1979
RECONNAISSANCE INVENTORY OF GRIZZLY BEAR ACTIVITY IN THE CENTENNI
AL MOUNTAIN RANGE.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 13
PP.

PRES DISTR	FOOD

YGBE,IDMT, , ,CENT

C0089

BLANCHARD, B.M. AND R.R. KNIGHT.

1980A
STATUS OF GRIZZLY BEARS IN THE YELLOWSTONE SYSTEM.

TRANS. NORTH AM. WILDL. AND NAT. RESOUR. CONF. 45:263-267.

POP EST　　BRD AGE　　LITR SIZE　　LITR FREQ
POP DENS　　MORT RATE

YGBE,IMW ,NPS ,USFS,

C0090

BLANCHARD, B.M. AND R.R.KNIGHT.

1980B
MOVEMENTS OF GRIZZLY BEARS IN THE YELLOWSTONE SYSTEM DURING 1978 AND 1979.

PP. 5-12 IN: R.R.KNIGHT, B.M. BLANCHARD, K.C. KENDALL AND L.E. OLDENBURG, EDS. YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS. U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 91 PP.

MOVE　　AGE/SEX　　WEIGHT　　HOME RNG

YGBE,IMW , , ,

C0091

BLANCHARD, B.M., R.R. KNIGHT AND E.M. YOUNT.

1980
MORTALITY.

PP. 20-23 IN: R.R. KNIGHT, B.M. BLANCHARD, K.C. KENDALL AND L.E. OLDENBURG, EDS. YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS. U.S.D.I. , INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 91 PP.

MORT DATA　　POACH/ILLEG　　CONTROL

YGBE,IMW , , ,

00092

BLANCQUAERT, A.-M.B., R.E. PORTER, JR., W.J. BRUYNINCKX AND R.C. CAMBRE.
1984
LYMPHOCARCOMA WITH PERFORATION OF THE ILEUM IN A GRIZZLY BEAR.

J. AM. VET. MED. ASSOC. 185(11):1433-1435.

PARAS/DIS

,GEN , , ,

00093

BLEICH, V.C.

1974
ABNORMAL DENTITION IN A GRIZZLY BEAR.

MURRELET 55(1):11.

DENT

,GEN , , ,

00094

BOERTJE, R.D., W.C., GASAWAY, S.D. DUBOIS, D.G. KELLYHOUSE, D.V. GR
ANGAARD, D.J. PRESTON AND R.O. STEPHENSON.
1985
FACTORS LIMITING MOOSE POPULATION GROWTH IN GAME MANAGEMENT UNIT
20E.

FED. AID WILDL. REST. PROJ. W-22-3 AND W-22-4, JOB 1.37R. PROG. R
EP. ALASKA DEP. FISH AND GAME, JUNEAU. 51 PP.

POP DENS PRED

AK-I,AK , , ,

00095

BOEVER, W.J.

1974
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PARAS/DIS ZOO TECH

,GEN , , ,

00096

BORDER GRIZZLY TECHNICAL COMMITTEE.

1975
MAJOR NATURAL RESOURCE ACTS - CONFLICTS WITHIN THEM, AND THEIR AP
PLICATION TO THE WELFARE OF THE GRIZZLY BEAR.

BORDER GRIZZLY TECH. COMM., BORDER GRIZZLY PROJ., UNIV. MONT., MI
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LEGAL

,GEN , , ,

00097

BOWMER, E.J.

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URSINE TRICHINOSIS IN BRITISH COLUMBIA, 1971.

CAN. J. PUBLIC HEALTH 64(1):84.

PARAS/DIS

,GEN , , ,

00098

BOYD, O.

1952
COMPILATION OF DATA ON WILDLIFE HARVEST.

FED. AID WILDL. REST. PROJ. W-3-R-7, JOB NO. 2, WORK PLAN D. ALAS
KA DEP. FISH AND GAME, JUNEAU. 6 PP.

HARV DATA

,AK , , ,

C0099

BOYD, O.

1953
BIG GAME, SMALL GAME AND FUR TAKE REPORT, JULY 1, 1952, TO JUNE 2
0, 1953, TERRITORY OF ALASKA.

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H AND GAME, JUNEAU. 1 PP.

HARV DATA

,AK , , ,

00100

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A NEW METHOD FOR DEALING WITH APIARY-RAIDING BLACK BEARS.

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71-577.

AVER COND DETER/REPEL

,GEN , , ,

00101

BRANNON, R.D.

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SERUM CHEMISTRY OF CENTRAL AND NORTHERN ALASKA GRIZZLY BEARS.

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HEMAT MORPH/PHYS

AK-I,AK ,ANWR, ,

00102

BRANNON, R.D.

1983B
BLOOD PROFILE OF GRIZZLY BEARS IN CENTRAL AND NORTHERN ALASKA.

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HEMAT MORPH/PHYS HEART
TEMP DRUGS

AK-I,AK ,ANWR, ,

00103

BRANNON, R.D.

1984
INFLUENCE OF ROADS AND DEVELOPMENTS ON GRIZZLY BEARS IN YELLOWSTO
NE NATIONAL PARK.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 52
PP.

ROAD IMP URBAN DEV HAB USE RECR IMP
DIVERSITY

YGBE,IMW ,YNP , ,

00104

BRANNON, R.D.

1985
HEMATOLOGICAL CHARACTERISTICS OF GRIZZLY BEARS (URSUS ARCTOS) IN
CENTRAL AND NORTHEASTERN ALASKA.

CAN. J. ZOOL. 63(1):58-62.

HEMAT

AK-I,AK , , ,

00105

BRATKOVICH, A.A.

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GRIZZLY BEAR HABITAT COMPONENTS ASSOCIATED WITH PAST LOGGING PRAC
TICES ON THE LIBBY RANGER DISTRICT, KOOTENAI NATIONAL FOREST.

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IN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

TIMB-HAB TIMB-METH TIMB-POST

CYE ,MT , ,KONF,

00106

BREWSTER, W.G.

1985
BIOLOGICAL OPINION ON MEATRACK-CARBONATE SHEEP ALLOTMENT, GALLATI
N NATIONAL FOREST.

U.S.D.I., FISH AND WILDL. SERV., HELENA, MONT. 5 PP.

LIVESTK MGMT

YGBE,MT ,GANF, ,

00107

BREWSTER, W.G.

1986A
BIOLOGICAL OPINION ON JARDINE JOINT VENTURE PROJECT.

U.S.D.I., FISH AND WILDL. SERV., HELENA MONT. 5 PP.

ENERGY IMP ENERGY MGMT

YGBE,MT ,GANF, ,JARD

00108

BREWSTER, W.G.

1986B
FORMAL CONSULTATION—INTERIM MANAGEMENT PLAN FOR OPERATION OF FIS
HING BRIDGE AND GRANT VILLAGE, YELLOWSTONE NATIONAL PARK.

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NONMOT MGMT MOTOR MGMT

YGBE,WY ,YNP , ,FISH

00109

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1979A
PROPOSED WILDLIFE MANAGEMENT PLAN FOR BRITISH COLUMBIA.

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MGMT GEN MGMT PLAN POL/ADM MGMT LEGAL

,BC , , ,

C0110

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1979B
PRELIMINARY GRIZZLY BEAR MANAGEMENT PLAN FOR BRITISH COLUMBIA.

B.C. FISH AND WILDL. BRANCH, VICTORIA. 25 PP.

MGMT PLAN PRES DISTR POP EST POP DENS
HARV DATA POACH/ILLEG

,BC , , ,

00111

BRITISH COLUMBIA MINISTRY OF ENVIRONMENT.

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BRITISH COLUMBIA HUNTING REGULATIONS SYNOPSIS 1985-1986.

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HARV MGMT

,BC , , ,

00112

BROMLEY, B.

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SAFETY IN BEAR COUNTY: A REFERENCE MANUAL.

NORTHWEST TERRITORIES, DEP. OF RENEWABLE RESOUR., YELLOWKNIFE.

GEN BIOL REACTION AVOID/ATTRAC CAMP MGMT
GARB MGMT ENERGY MGMT DETER/REPEL

,NWT , , ,

00113

BROMLEY, B.

1986
SAFETY IN GRIZZLY AND BLACK BEAR CCUNTRY.

NORTHEAST TERRIT., DEP. OF RENEWABLE RESOUR., YELLOWKNIFE. 24 PP.

EDUC GEN BIOL AVOID/ATTRAC CAMP MGMT
GARB MGMT DETER/REPEL

,NWT , , ,

00114

BROMLEY, M.

1985
WILDLIFE MANAGEMENT IMPLICATIONS OF PETROLEUM EXPLORATION AND DEV
ELOPMENT IN WILDLAND ENVIRONMENTS.

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BIBLIO ENERGY IMP

,GEN , , ,

00115

BROWN, D.E.

1985
THE GRIZZLY IN THE SOUTHWEST.

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HIST ACCT HIST DISTR PRES DISTR GEN BIOL

,SWMX, , ,

00116

BROWN, G.W., H.J. CROSS AND S.J. RILEY.

1984
BIG GAME SURVEY AND INVENTORY. WILDLIFE INVESTIGATIONS, REGION ON
E.

FED. AID WILDL. REST PROJ. W-130-R-15, JOB NO. I-1. PROG. REP., J
ULY 1, 1983-JUNE 30, 1984. MONT. DEP. FISH, WILDL. AND PARKS, HEL
ENA. 37 PP.

HARV DATA MORT DATA

NCDE,MT , , ,

00117

BROWN, G.W., H.J. CROSS AND S.J. RILEY.

1985
BIG GAME SURVEY AND INVENTORY. WILDLIFE INVESTIGATIONS, REGION ON
E.

FED. AID WILDL. REST PROJ. W-130-R-16, JOB NO. I-1. PROG. REP., J
ULY 1, 1984-JUNE 30, 1985. MONT. DEP. FISH, WILDL. AND PARKS, HEL
ENA. 46 PP.

HARV DATA

NCDE,MT , , ,

00118

BROWN, R.L.

1959
INVESTIGATIONS OF REPORTED BEAR DEPREDATIONS ON LIVESTOCK.

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1, 1958-APRIL 30, 1959. MONT. FISH AND GAME DEP., HELENA. 12 PP.

DEPRED CONTROL LIVESTK IMP

,MT , , ,

00119

BROWN, R.L.

1960A
PREDATOR AND WILDLIFE DAMAGE SURVEYS.

FED. AID WILDL. REST. PROJ. W-49-R-9, JOB III-B. JOB COMPLETION R
EP., MAY 1, 1959-APRIL 30, 1960. MONT. FISH AND GAME DEP., HELENA
. 104 PP.

DEPRED

,MT , , ,

00120

BROWN, R.L.

1960B
INVESTIGATION OF REPORTED BEAR DEPREDATIONS ON LIVESTOCK.

FED. AID WILDL. REST. PROJ. W-49-R-9, JOB III-C. JOB COMPLETION R
EP., MAY 1, 1959-APRIL 30, 1960. MONT. FISH AND GAME DEP., HELENA
. 18 PP.

CONTROL DEPRED LIVESTK IMP

,MT , , ,

00121

BROWN, R.L.

1960C
STUDY OF PREDATOR ECOLOGY IN SUN RIVER AREA.

FED. AID WILDL. REST. PROJ. W-49-R-9, JOB III-D. JOB COMPLETION R
EP., MAY 1, 1959-APRIL 30, 1960. MONT. FISH AND GAME DEP., HELENA
. 3 PP.

PRED

NCDE,MT , , ,SUNR

00122

BROWNE, S.D.

1962
LIST OF PARASITES REPORTED FROM BEARS.

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D GAME, ALBANY. 7 PP.

PARAS/DIS

,GEN , , ,

00123

BRYAN, R.B. AND M.C. JANSSON.

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PERCEPTION OF WILDLIFE HAZARD IN NATIONAL PARK USE.

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PUBLIC ATT

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00124

BUMGARNER, T.

1979
NUTRIENT AND HABITAT EVALUATION OF INFERRED GRIZZLY BEAR FOODS.

B.S. THESIS, UNIV. MONT., MISSOULA. 49 PP.

NUTR ANAL

NCDE,MT ,FLNF, ,WHR

00125

BUMGARNER, T., R.D. MACE AND C. JONKEL.

1980
CAMBIUM USE BY GRIZZLY BEARS.

PP. 196-203 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ ., UNIV. MONT., MISSOULA. ANNU. REP. NO. 5.

FOOD TIMB USE

NCDE,MT , , ,

00126

BUNNELL, F.L. AND T. HAMILTON.

1983
FORAGE DIGESTIBILITY AND FITNESS IN GRIZZLY BEARS.

INT. CONF. BEAR RES. AND MANAGE. 5:179-185.

NUTR ANAL DIGEST WEIGHT GROW/DEV
MORPH/PHYS

,GEN , , ,

00127

BUNNELL, F.L. AND D.E.N. TAIT.

1980
BEARS IN MODELS AND IN REALITY - IMPLICATIONS TO MANAGEMENT.

INT. CONF. BEAR RES. AND MANAGE. 4:15-23.

DEMOG ANAL HARV MGMT

,GEN , , ,

00128

BUNNELL, F.L. AND D.E.N. TAIT.

1981
POPULATION DYNAMICS OF BEARS - IMPLICATIONS.

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WEIGHT REP RATE MORT RATE POP REG
AGE/SEX

,GEN , , ,

00129

BUNNELL, F.L. AND D.E.N. TAIT.

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MORTALITY RATES OF NORTH AMERICAN BEARS.

ARCTIC 38(4):316-323.

DEMOG ANAL AGE/SEX MORT RATE HARV IMP
HARV DATA HOME RNG

,GEN , , ,

00130

BURBRIDGE, B. AND L. KRUCKENBERG (CHAIRMEN)

1985
GRIZZLY BEAR US IN MIND: INFORMATION/EDUCATION ACTION PLAN.

INTERAGENCY GRIZZLY BEAR COMM. PUBLIC INF./EDUC. TASK FORCE. REP.

EDUC

,US , , ,

00131

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FLATHEAD INDIAN RESERVATION GRIZZLY BEAR MANAGEMENT PLAN. REVIEW DRAFT.

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MGMT PLAN NONMOTOR IMP NONMOT MGMT LIVESTK MGMT
URBAN DEV SUBDIV MGMT TIMB MGMT CONTROL
LIVESTK IMP
NCDE,MT ,FLIR, ,

00132

BURNS, J.E.

1986
MANAGING POLITICAL HABITAT FOR GRIZZLY BEAR RECOVERY.

PP. 2-13 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

POL/ADM MGMT MGMT GEN MORT DATA LIVESTK IMP

,US , , ,

00133

BUSH, M., R.S. CUSTER AND E.E. SMITH.

1980
USE OF DISSOCIATIVE ANESTHETICS FOR THE IMMOBILIZATION OF CAPTIVE BEARS: BLOOD GAS, HEMATOLOGY AND BIOCHEMISTRY VALUES.

J. WILDL. DIS. 16(4)):481-489.

DRUGS HEMAT

,GEN , , ,

00134

BUSKIRK, S. AND L.A. JOHNSON.

1976A
CHRONOLOGY OF HUMAN INJURIES INFLICTED BY BEARS.

U.S.D.I., NATL. PARK SERV., DENALI NATL. PARK, ALASKA. UPDATED AN NUALLY. 4 PP.

HUMAN INJ

AK-I,AK ,DENP, ,

00135

BUSKIRK, S. AND L.A. JOHNSON.

1976B
BEAR HANDLING ACTIONS.

U.S.D.I., NATL. PARK SERV., DENALI NATL. PARK, ALASKA. UPDATED AN NUALLY. 8 PP.

CONTROL RELOC POACH/ILLEG DEPRED
RECR IMP

AK-I,AK ,DENP, ,

00136

BUTTERFIELD, B.R. AND J.A. ALMACK.

1985
EVALUATION OF GRIZZLY BEAR HABITAT IN THE SELWAY-BITTERROOT WILDE RNESS AREA.

IDAHO COOP. WILDL. RES. UNIT, UNIV. IDAHO, MOSCOW. 66 PP.

HAB RECON TYPE DESCRIP

SBE ,IDMT,USFS, ,SBWA

00137

BUTTERFIELD, B.R. AND C.H. KEY.

1986
MAPPING GRIZZLY BEAR HABITAT IN GLACIER NATIONAL PARK USING A STR
ATIFIED LANDSAT CLASSIFICATION: A PILOT STUDY.

PP. 58-66 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRI
ZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN
 RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-270.

MAP/TYPE   TYPE DESCRIP

NCDE,MT   ,GLNP,   ,TWOM

00138

CAHALANE, V.H.

1948
THE STATUS OF MAMMALS IN THE U.S. NATIONAL PARK SYSTEM, 1947.

J. MAMMAL. 29(3):247-259.

HIST DISTR

,GEN ,   ,   ,

00139

CAHALANE, V.H.

1964
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Y, AND WOLF IN NORTH AMERICA.

N.Y. ZOOL. SOC., BRONX, N.Y. 12 PP.

HIST DISTR

,GEN ,   ,   ,

00140

CAMPBELL, B.H.

1985
BROWN BEAR ACTIVITY AND IMPACTS ON NESTING GEESE ON THE WEST COPP
ER RIVER DELTA - 1984.

ALASKA DEP. FISH AND GAME, ANCHORAGE. PROG. REP. 25 PP.

PRED   AGE/SEX   HOME RNG
FOOD   AIRCRAFT IMP   POP DENS   MEAS/QUANT

AKSC,AK ,   ,   ,COPR

00141

CAMPBELL, B.H. AND T.C. ROTHE.

1985
ANNUAL REPORT OF SURVEY-INVENTORY ACTIVITIES.

FED. AID WILDL. REST. PROJ. W-22-3, JOB 11.0. ANNUAL REP., VOL. X
V. ALASKA DEP. FISH AND GAME, JUNEAU.

PRED AGE/SEX HCME RNG HAB USE

AK-I,AK , , ,COPR

00142

CARLSON, K.

N.D.
AN ANALYSIS OF INFORMATION HANDLING FOR BEAR MANAGEMENT.

U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 5 PP.

MONIT SYS

NCDE,MT ,GLNP, ,

00143

CASEY, D., C.A. YDE AND A. OLSEN.

1984
WILDLIFE LOSS ESTIMATES AND SUMMARY OF PREVIOUS MITIGATION RELATE
D TO HYDROELECTRIC PROJECTS IN MONTANA.

FINAL REP. PREP. FOR BONNEVILLE POWER ADM. PROJ. NO. 83-464. PREP
. BY MONT. DEP. FISH, WILDL. AND PARKS, HELENA. 66 PP.

ENERGY IMP

NCDE,MT ,FLNF, ,HUNG

00144

CAUGHLEY, G.

1974
INTERPRETATION OF AGE RATIOS.

J. WILDL. MANAGE. 38(3):557-562.

DEMOG ANAL AGE/SEX HARV MGMT

,GEN , , ,

00145

CAUGHLEY, G. AND J. GODDARD.

1972
IMPROVING THE ESTIMATES FROM INACCURATE CENSUSES.

J. WILDL. MANAGE. 36(1):135-140.

CENSUS METH

,GEN , , ,

00146

CHADWICK, D. H.

1974
GRIZZLY BEAR SURVEY IN A SELECTED PORTION OF THE SWAN RANGE OF WE
STERN MONTANA.

MANUSCRIPT. 21 PP.

PRES DISTR CENSUS/TREND MORT DATA TIMB IMP

NCDE,MT ,FLNF, ,SWAN

00147

CHAMBERS, M.

1975
NUISANCE BEARS . . . WHY???

WILDL. REV. 7(7):20-22.

CAPTURE

,GEN , , ,

00148

CHAPMAN, J.A., J.I. ROMER AND J. STARK.

1955
LADYBIRD BEETLES AND ARMY CUTWORM ADULTS AS FOOD FOR GRIZZLY BEAR
S IN MONTANA.

ECOLOGY 36(1):156-158.

FOOD FEED BEH

NCDE,MT ,FLIR, ,MCPK

00149

CHATELAIN, E. F.

1950
BEAR-MOOSE RELATIONSHIPS ON THE KENAI PENINSULA.

TRANS. NORTH AM. WILDL. CONF. 15:224-234.

FOOD PRED

AKPN,AK , , ,

C0150

CHESTER, J.M.

1976
HUMAN WILDLIFE INTERACTIONS IN THE GALLATIN RANGE, YELLCWSTONE NA TIONAL PARK, 1973-1974.

M.S. THESIS, MONT. STATE UNIV., BOZEMAN. 114 PP.

REACTION PUBLIC ATT AVOID/ATTRAC NONMOTOR IMP NONMOT MGMT

YGBE,WY ,YNP , ,GALL

00151

CHESTER, J. M.

1980
FACTORS INFLUENCING HUMAN-GRIZZLY BEAR INTERACTIONS IN A BACKCOUN TRY SETTING.

INT. CONF. BEAR RES. AND MANAGE. 4:351-357.

NONMOTOR IMP REACTION

YGBE,MT ,YNP , ,GALL

00152

CHILDRESS, M.

1985
RECREATION MANAGEMENT IN GRIZZLY COUNTRY. 1985 ACTION PLAN.

U.S.D.A., FOREST SERV., BRIDGER-TETON NATL. FOREST, JACKSON, WYO.

EDUC CAMP MGMT MOTOR MGMT NONMOT MGMT GARB MGMT

YGBE,WY ,BTNF, ,

00153

CHOQUETTE, L. P. E., G. G. GIBSON AND A. M. PEARSON.

1969
HELMINTHS OF THE GRIZZLY BEAR, URSUS ARCTOS L., IN NORTHERN CANAD
A.

CAN. J. ZOOL. 47:167-170.

PARAS/DIS

,YK , , ,

00154

CHRISTENSEN, A.G.

1982
CUMULATIVE EFFECTS ANALYSIS PROCESS.

SECTION I, 22 PP. IN: CUMULATIVE EFFECTS ANALYSIS PROCESS. GRIZZL
Y HABITAT COMPONENT MAPPING. U.S.D.I., NATL. PARK SERV., KOOTENAI
NATL. FOREST, MONT.

MAP/TYPE CUM EFF

CYE ,IDMT,KONF, ,CAB

00155

CHRISTENSEN, A.G.

1986
CUMULATIVE EFFECTS ANALYSIS: ORIGINS, ACCEPTANCE, AND VALUE TO GR
IZZLY BEAR MANAGEMENT.

PP. 213-216 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-G
RIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTA
IN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

CUM EFF

CYNC,MT ,KONF, ,

00156

CHRISTENSEN, A., R. ESCANO, P. HARRINGTON, C. HRUSKA, T. PUCHLERZ A
ND L. YOUNG.
1984
TECHNOLOGY TRANSFER PLAN, GRIZZLY BEAR CUMULATIVE EFFECTS ANALYSI
S, NORTHERN REGION.

U.S.D.A., FOREST SERV., NORTH. REG., MISSOULA, MONT. 15 PP.

MAP/TYPE CUM EFF MGMT GEN POL/ADM MGMT
EDUC

,IDMT, , ,

00157

CHRISTENSEN, A.G. AND M.J. MADEL.

1982
CUMULATIVE EFFECTS ANALYSIS PROCESS, GRIZZLY HABITAT COMPONENT MA
PPING.

U.S.D.A., FOREST SERV., KOOTENAI NATL. FOREST, MONT. 99 PP.

CUM EFF   MAP/TYPE

CYE ,IDMT,KONF,   ,CAB

00158

CHRISTENSEN, A.G. AND M.J. MADEL.

1984
A CUMULATIVE EFFECTS ANALYSIS PROCESS FOR GRIZZLY BEAR HABITAT, C
ABINET MOUNTAINS, MONTANA.

THORNE ECOL. INST. TECH. PUBL. 14:142-132.

COVER   HOME RNG   CUM EFF   MAP/TYPE

CYE ,MT ,KONF,   ,CAB

00159

CHURCHER, C.S. AND A.V. MORGAN.

1976
A GRIZZLY BEAR FROM THE MIDDLE WISCONSIN OF WOODBRIDGE, ONTARIO.

CAN. J. EARTH SCI. 13(2):341-347.

HIST DISTR

,ONT ,   ,   ,

00160

CLAAR, J.J., R.W. KLAVER AND C. SERVHEEN.

1981
GRIZZLY BEAR/LIVESTOCK RELATIONSHIPS: A MANAGEMENT CHALLENGE ON T
HE FLATHEAD INDIAN RESERVATION.

PRES. AT WILDLIFE/LIVESTOCK RELATIONSHIPS SYMPOSIUM. 20-22 APR. 1
981, COEUR D'ALENE, IDAHO. 9PP.

DEPRED   LIVESTK IMP

NCDE,MT ,FLIR,   ,

00161

CLAAR, J. J., R. W. KLAVER AND C. W. SERVHEEN.

IN PRESS
GRIZZLY BEAR MANAGEMENT ON THE FLATHEAD INDIAN RESERVATION, MONTANA.

INT. CONF. BEAR RES. AND MANAGE. 6.

MORT MGMT	MORT DATA	HARV DATA	DEPRED
CONTROL	MONIT SYS	AGE/SEX	MGMT GEN

NCDE,MT ,FLIR, ,

00162

CLARK, T., M. WELLS, J. HOAK AND J. WEAVER.

1977
STATUS OF GRIZZLY BEARS IN BRIDGER-TETON NATIONAL FOREST, WYOMING ; PART 1:TETON WILDERNESS.

WEST. ENVIRON. RES. ASSOC., POCATELLO, IDAHO. PROG. REP. 23 PP.

PRES DISTR	CENSUS/TREND	AGE/SEX	LITR SIZE
POP DENS	FOOD		

YGBE,WY ,BTNF, ,TEWI

00163

CLARK, W.K.

1955
BEAR STUDY - KARLUK LAKE, 1955.

U.S. BUREAU OF COMMERCIAL FISHERIES, KODIAK NATL. WILDL. REFUGE. 41 PP.

CENSUS/TREND	HARV DATA	AGE/SEX	MOVE
FOOD	PRED		

AKKA,AK , , ,KARL

00164

CLARK, W.K.

1957
SEASONAL FOOD HABITS OF THE KODIAK BEAR.

TRANS. NORTH AM. WILDL. CONF. 22:145-151.

FOOD

AKKA,AK ,KNWR, ,KOIS

00165

CLARK, W.K.

1959
KODIAK BEAR-RED SALMON RELATIONSHIPS AT KARLUK LAKE, ALASKA.

TRANS. NORTH AM. WILDL. CONF. 24:337-345.

FOOD CENSUS/TREND PRED

AKKA,AK , , ,KOIS

00166

CLARK, W.K.

1960
THE ELECTRIC FENCE AS A DETERRENT TO USE OF SALMON STREAMS BY KOD
IAK BEAR.

PROC. ALASKA SCI. CONF. 8:24-26.

DETER/REPEL

AKKA,AK , , ,KARL

00167

CLARKSON, P.

1986
SAFETY IN BEAR COUNTRY: INSTRUCTORS GUIDE.

GOV. NORTHWEST TERRIT., DEP. RENEWABLE RESOURCES, YELLOWKNIFE. 29
+ PP.

EDUC

,GEN , , ,

00168

CLARKSON, P. AND L. SUTTERLIN.

1984
BEAR ESSENTIALS: A SOURCE BOOK AND GUIDE TO PLANNING BEAR EDUCATI
ON PROGRAMS.

DISTRIBUTED BY C. JONKEL, SCHOOL OF FOR., UNIV. OF MONT., MISSOUL
A. 67 PP.

EDUC GEN BIOL

,GEN , , ,

00169

COE, D.L.

1967
BEAR MANAGEMENT ACTIVITIES.

MEMO. TO SUPERINTENDENT, KATMAI NATL. PARK AND PRESERVE, ALASKA.
2 PP.

DEPRED HUMAN INJ CONTROL

AKPN,AK ,KANM, ,

00170

COFFEY, M.A.

1983
PRELIMINARY REPORT ON BEAR-PROOF BACKPACK FOOD CANISTER, 1983.

U.S.D.I., NATL. PARK SERV., SEQUOIA AND KINGS CANYON NATL. PARKS, CALIF. 9 PP.

CAMP MGMT

,GEN , , ,

00171

COLE, G.F.

1971
PROGRESS IN RESTORING A NATURAL GRIZZLY BEAR POPULATION IN YELLOW STONE NATIONAL PARK.

PP. 183-193 IN: RESEARCH IN THE PARKS, TRANS. OF THE NATL. PARKS CENTENNIAL SYMP., U.S.D.I., NATL. PARK SERV. SYMP. SER. NO. 1.

MGMT GEN GARB MGMT GARBAGE CONTROL
RELOC POP REG POP EST CAMP MGMT

YGBE,IMW ,YNP , ,

00172

COLE, G.F.

1972A
INTERIM REPORT ON GRIZZLY BEAR MANAGEMENT IN YELLOWSTONE NATIONAL PARK, 1972.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. 13 PP.

HUMAN INJ POP EST CONTROL RELOC
REP RATE GARB MGMT MGMT GEN GARBAGE

YGBE,IMW ,YNP , ,

00173

COLE, G.F.

1972B
GRIZZLY BEAR-ELK RELATIONSHIPS IN YELLOWSTONE NATIONAL PARK.

J. WILDL. MANAGE. 36(2):556-561.

PRED SEAS BEH FEED BEH CARCASS

YGBE,IMW ,YNP , ,

00174

COLE, G.F.

1972C
RESTORATION OF A NATURAL GRIZZLY BEAR POPULATION IN YELLOWSTONE N
ATIONAL PARK.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. INF. PA
P. NO. 15. 1 PP.

MGMT GEN GARB MGMT CONTROL HUMAN INJ
GARBAGE

YGBE,IMW ,YNP , ,

00175

COLE, G.F.

1972D
PRESERVATION AND MANAGEMENT OF GRIZZLY BEARS IN YELLOWSTONE NATIO
NAL PARK.

INT. CONF. BEAR RES. AND MANAGE. 2:274-288.

CONTROL HUMAN INJ GARB MGMT CAMP MGMT
RELOC MGMT GEN POP EST POP DENS

YGBE,IMW ,YNP , ,

00176

COLE, G.F.

1973
MANAGEMENT INVOLVING GRIZZLY BEARS IN YELLOWSTONE NATIONAL PARK,
1970-72.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. RES. REP
. NO. 6, YELL-N-38. 32 PP.

MGMT GEN CONTROL POP REG POP DENS
HUMAN INJ MORT DATA POP EST DEMOG ANAL
GARBAGE
YGBE,IMW ,YNP ,USFS,

00177

COLE, G.F.

1974
MANAGEMENT INVOLVING GRIZZLY BEARS AND HUMANS IN YELLOWSTONE NATI
CNAL PARK, 1970-73.

BIOSCIENCE 24(6):335-338.

HUMAN INJ	CONTROL	REP RATE	MORT DATA
DEMOG ANAL	MGMT GEN	POP EST	

YGBE,IMW ,YNP , ,

00178

COLE, G.F.

1975
MANAGEMENT INVOLVING GRIZZLY BEARS IN YELLOWSTONE NATIONAL PARK,
1970-74.

PRES. AT 26TH ANNU. AM. INST. BIOL. SCI. MEET., OREGON STATE UNIV
., CORVALLIS, OREG. 34 PP.

MGMT GEN	MONIT SYS	HUMAN INJ	CONTROL
REP RATE	POP EST	DEMOG ANAL	

YGBE,IMW ,YNP , ,

00179

COLE, G.F.

1976
MANAGEMENT INVOLVING GRIZZLY AND BLACK BEARS IN YELLOWSTONE NATIO
NAL PARK, 1970-75.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. RES. REP
. NO. 9. 26 PP.

MONIT SYS	MGMT GEN	HUMAN INJ	SEAS BEH
CONTROL	REP RATE	DEMOG ANAL	RECR MGMT

YGBE,IMW ,YNP , ,

C0180

COLMENARES, F. AND H. RIVERO.

1983A
DISPLAYS OCCURRING DURING CONFLICT SITUATIONS CONVEY CHEMICAL AND
VISUAL INTIMIDATION MESSAGES IN BEARS LIVING UNDER CAPTIVE GROUP
CONDITIONS.

ACTA ZOOL. FENN. 174:145-148.

THREAT	MARK	AGON

,GEN , , ,

00181

COLMENARES, F. AND H. RIVERO.

1983B
MALE-MALE TOLERANCE, MATE SHARING AND SOCIAL BONDS AMONG ADULT MA
LE BROWN BEARS LIVING UNDER GROUP CONDITIONS IN CAPTIVITY.

ACTA ZOOL. FENN. 174:149-151.

INTRASP BEH　　COURT　　AGON

,GEN , , ,

C0182

COLORADO WILDLIFE COMMISSION.

1982
RESOLUTION REGARDING INTRODUCTION OF GRIZZLY BEAR AND GRAY (TIMBE
R) WOLF IN COLORADO.

COLO. DEP. NAT. RESOUR., DIV. OF WILDL., DENVER. 1 PP.

LEGAL　　POL/ADM MGMT　　INT/REINT

,CO , , ,

00183

COMPUHEAT SERVICES CANADA LTD.

1986
INFRA-RED DETECTION AND ACOUSTIC DETERRENT STUDY, CAPE CHURCHILL,
MANITOBA, 1984.

PREP. FOR GOV. OF NORTHWEST TERRIT., DEP. RENEWABLE RESOUR., YELL
OWKNIFE BY COMPUHEAT SERV. CAN. INC., CALGARY, ALBERTA. REP. NO.
55. 49 PP.

DETER/REPEL

,GEN , , ,

C0184

CONOVER, M.R., J.G. FRANCIK AND D.E. MILLER.

1977
AN EXPERIMENTAL EVALUATION OF AVERSIVE CONDITIONING FOR CONTROLLI
NG COYOTE PREDATION.

J. WILDL. MANAGE. 41(4):775-779.

AVER COND

,GEN , , ,

00185

CONTRERAS, G.P. AND K.E. EVANS, (EDS.).

1986
PROCEEDINGS - GRIZZLY BEAR HABITAT SYMPOSIUM.

U.S.D.A., FOREST SERV. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207. 252 PP.

HAB USE TIMB MGMT HAB EFFECT TIMB IMP HAB ANAL TIMB-METH HAB RECON TIMB-POST

,GEN , , ,

00186

COONEY, R. F.

1941
GRIZZLY BEAR STUDY.

FED. AID WILDL. REST. PROJ. COMPLETION REP. MONT. DEP. FISH AND GAME, HELENA. 17 PP.

CENSUS/TREND POP DENS FOOD DEN CHRON

NCDE,MT ,LCNF,FLNF,

00187

COONEY, R.F.

1947
GRIZZLY BEAR NOTES.

PROC. ANNU. CONF. WEST. ASSOC. STATE FISH AND GAME COMMISSIONERS 27:122-126.

CENSUS/TREND POP DENS FOOD

NCDE,MT ,LCNF,FLNF,

00188

COUEY, F.M. AND R.P. WECKWERTH.

1965
BIG GAME SURVEYS AND INVESTIGATIONS.

FED. AID WILDL. REST. PROJ. W-71-R-10, JOB A-1. JOB COMPLETION REP., JULY 1, 1964-JUNE 30, 1965. MONT. FISH AND GAME DEP., HELENA. 24 PP.

CONTROL DEPRED HARV DATA POACH/ILLEG

NCDE,MT , , ,

C0189

COUEY, F.M. AND R.P. WECKWERTH.

1966
BIG GAME SURVEYS AND INVESTIGATIONS.

FED. AID WILDL. REST. PROJ. W-71-R-11, JOB A-1. JOB COMPLETION RE
P., JULY 1, 1965-JUNE 30, 1966. MONT. FISH AND GAME DEP., HELENA.
15 PP.

HARV DATA

NCDE,MT , , ,

C0190

COUEY, F.M. AND R.P. WECKWERTH.

1968
BIG GAME SURVEYS AND INVESTIGATIONS.

FED. AID WILDL. REST. PROJ. W-71-R-11, JOB A-1. JOB COMPLETION RE
P., JULY 1, 1967-JUNE 30, 1968. MONT. FISH AND GAME DEP., HELENA.
19 PP.

HARV DATA

NCDE,MT , , ,

00191

COURTNEY, J.

1976
NOTES ON THE BEHAVIOR OF A MATING PAIR OF GRIZZLY BEARS (URSUS AR
CTOS).

MANUSCRIPT. 22 PP.

COURT

CR ,AT ,BANP, ,CASC

00192

COURTRIGHT, A.M.

1965
1963-1964 REPORT ON GAME HARVEST.

FED. AID WILDL. REST. PROJ. W-6-R-5, WORK PLAN K. PROJ. SEGMENT R
EP., VOL. V, NO. 2. ALASKA DEP. FISH AND GAME, JUNEAU. 25 PP.

HARV DATA AGE/SEX

,AK , , ,

00193

COURTRIGHT, A.M.

1968
GAME HARVESTS IN ALASKA.

FED. AID WILDL. REST. PROJ. W-6-R-7. ALASKA DEP. FISH AND GAME, J
UNEAU. 70 PP.

HARV DATA

,AK , , ,

00194

COWAN, I.M.

1972
THE STATUS AND CONSERVATION OF BEARS (URSIDAE) OF THE WORLD - 197
0.

INT. CONF. BEAR RES. AND MANAGE. 2:343-367.

PRES DISTR	POP EST	HARV DATA	POP DENS
HARV MGMT	HARV IMP	MGMT GEN	

,GEN , , ,

00195

COWAN, I.M., D.G. CHAPMAN, R.S. HOFFMAN, D.R. MCCULLOUGH, G.A. SWAN
SON AND R.B. WEEDEN.
1974
REPORT OF THE COMMITTEE ON THE YELLOWSTONE GRIZZLIES.

NATL. ACAD. SCI., WASHINGTON, D.C. 61 PP.

HIST DISTR	POP EST	POP DENS	CONTROL
REP RATE	MORT RATE	DEMOG ANAL	POP REG
MGMT GEN			

YGBE,IMW ,YNP ,USFS,

00196

CRAIGHEAD, F.C., JR.

1976
GRIZZLY BEAR RANGES AND MOVEMENT AS DETERMINED BY RADIOTRACKING.

INT. CONF BEAR RES. AND MANAGE. 3:97-109.

HOME RNG	TERR/SPACE	MOVE	CARCASS
POP DENS	MGMT GEN	RELOC	CONTROL

YGBE,IMW ,YNP , ,

00197

CRAIGHEAD, F.C., JR.

1979
TRACK OF THE GRIZZLY.

SIERRA CLUB BOOKS, SAN FRANCISCO. 262 PP.

DEN	COURT	HOME RNG	MOVE
INTRASP BEH	POP BIOL	HIB PHYS	MATERNAL
TERR/SPACE			

YGBE,IMW ,YNP , ,

00198

CRAIGHEAD, F.C., JR. AND J.J. CRAIGHEAD.

1963
RADIOTRACKING OF GRIZZLY BEARS IN YELLOWSTONE NATIONAL PARK, WYOM ING.

PP. 59-67; IN: P.H. OEHSER, ED. NATL. GEOGR. SOCIETY RES. REP., 1 964. NATL. GEOGR. SOC., WASHINGTON, D.C.

DEN CHRON	HOME RNG	MOVE	FOOD

YGBE,WY ,YNP , ,

00199

CRAIGHEAD, F.C., JR., J.J. CRAIGHEAD AND R.S. DAVIES.

1963
RADIOTRACKING OF GRIZZLY BEARS.

BIOTELEMETRY: 133-148.

TELEM

YGBE,IMW ,YNP , ,

00200

CRAIGHEAD, F.C., JR. AND J.J. CRAIGHEAD.

1964
GRIZZLY BEAR ECOLOGICAL FINDINGS OBTAINED BY BIO-TELEMETRY.

MONT. COOP. WILDL. RES. UNIT, UNIV. MONT., MISSOULA. 31 PP.

TELEM	HOME RNG	MOVE	PRED
INTRASP BEH	REACTION	SIGHT	

YGBE,IMW ,YNP , ,

00201

CRAIGHEAD, F.C., JR. AND J.J. CRAIGHEAD.

1965
TRACKING GRIZZLY BEARS.

BIOSCIENCE 15(2):88-92.

DEN TELEM MOVE HOME RNG
FOOD

YGBE,WY ,YNP , ,

00202

CRAIGHEAD, F.C., JR. AND J.J. CRAIGHEAD.

1969
RADIOTRACKING OF GRIZZLY BEARS IN YELLOWSTONE NATIONAL PARK, WYOMING, 1964.

PP. 35-43 IN: P.H. OEHSER, ED. NATIONAL GEOGRAPHIC SOCIETY RESEARCH REPORTS, 1964. NATL. GEOGR. SOC., WASHINGTON, D.C.

HOME RNG DEN SEAS BEH MOVE
TELEM

YGBE,IMW ,YNP , ,

00203

CRAIGHEAD, F.C., JR. AND J.J. CRAIGHEAD.

1970
RADIOTRACKING OF GRIZZLY BEARS IN YELLOWSTONE NATIONAL PARK, WYOMING, 1962.

PP. 63-71 IN: P.H. OEHSER, ED. NATIONAL GEOGRAPHIC SOCIETY RESEARCH REPORTS, 1961-1962. NATL. GEOGR. SOC., WASHINGTON, D.C.

POP BIOL CONTROL HARV DATA SEAS BEH
MOVE WEIGHT AGE DETERM INTRASP BEH
HEMAT

YGBE,WY ,YNP , ,

00204

CRAIGHEAD, F.C., JR. AND J.J. CRAIGHEAD.

1971
BIOTELEMETRY RESEARCH WITH GRIZZLY BEARS AND ELK IN YELLOWSTONE NATIONAL PARK, WYOMING, 1965.

PP. 49-62 IN: P.H. OEHSER, ED. NATIONAL GEOGRAPHIC SOCIETY RESEARCH REPORTS, 1965. NATL. GEOGR. SOC., WASHINGTON, D.C.

DEN CHAR DEN HOME RNG SEAS BEH
INTRASP BEH TERR/SPACE TELEM
WEAN

YGBE,WY ,YNP , ,

00205

CRAIGHEAD, F.C., JR. AND J.J. CRAIGHEAD.

1972A
GRIZZLY BEAR PREHIBERNATION AND DENNING ACTIVITIES AS DETERMINED BY RADIOTRACKING.

WILDL. MONOGR. NO. 32. 35 PP.

HIB PHYS TELEM DEN CHAR DEN SITE
MOVE DEN CHRON DAY BED HOME RNG
INTRASP BEH
YGBE,WY ,YNP , ,

00206

CRAIGHEAD, F.C, JR. AND J.J. CRAIGHEAD.

1972B
RADIOTRACKING OF GRIZZLY BEARS AND ELK IN YELLOWSTONE NATIONAL PARK, WYOMING, 1959-1960.

PP. 55-62 IN: P.H. OEHSER, ED. NATIONAL GEOGRAPHIC SOCIETY RESEARCH REPORTS, 1955-1960. NATL. GEOGR. SOC., WASHINGTON, D.C.

TELEM RES TECH DRUGS

YGBE,WY ,YNP , ,

00207

CRAIGHEAD, F.C., JR. AND J.J. CRAIGHEAD.

1972C
DATA ON GRIZZLY BEAR DENNING ACTIVITIES AND BEHAVIOR OBTAINED BY USING WILDLIFE TELEMETRY.

INT. CONF. BEAR RES. AND MANAGE. 2:84-106.

TELEM DEN SITE ORPHAN DEN CHAR
DEN CHRON DAY BED MOVE INTRASP BEH
REACTION
YGBE,WY ,YNP , ,

00208

CRAIGHEAD, F.C, JR. AND J.J. CRAIGHEAD.

1973
RADIOTRACKING OF GRIZZLY BEARS AND ELK IN YELLOWSTONE NATIONAL PARK, WYOMING, 1966.

PP. 33-48 IN: P.H. OEHSER, ED. NATIONAL GEOGRAPHIC SOCIETY RESEARCH REPORTS, 1966. NATL. GEOGR. SOC., WASHINGTON, D.C.

DEN DEN CHAR DEN CHRON INTRASP BEH

YGBE,WY ,YNP , ,

C0209

CRAIGHEAD, F.C., JR. AND J.J. CRAIGHEAD.

1974
RADIOTELEMETRY RESEARCH ON LARGE WESTERN MAMMALS IN YELLOWSTONE N
ATIONAL PARK, WYOMING, 1967.

PP. 35-51 IN: P.J. OEHSER, ED. NATIONAL GEOGRAPHIC SOCIETY RESEAR
CH REPORTS, 1967. NATL. GEOGR. SOC., WASHINGTON, D.C.

HOME RNG HIB PHYS TELEM

YGBE,IMW ,YNP ,USFS,

C0210

CRAIGHEAD, J.J.

1977
A DELINEATION OF CRITICAL GRIZZLY BEAR HABITAT IN THE YELLOWSTONE
REGION.

MONT. COOP. WILDL. RES. UNIT, UNIV. MONT., MISSOULA.

DISTR GEN DATA GARBAGE MORT DATA
DEN SITE RECR IMP LIVESTK IMP TIMB IMP
ZONING
YGBE,IMW , , ,

00211

CRAIGHEAD, J.J.

1980
A PROPOSED DELINEATION OF CRITICAL GRIZZLY BEAR HABITAT IN THE YE
LLOWSTONE REGION.

BEAR BIOL. ASSOC. MONOGR. SER. NO. 1. 20 PP.

GEN DATA HAB USE RECR IMP LIVESTK IMP
TIMB IMP MORT DATA HARV DATA ZONING
PRES DISTR
YGBE,IMW ,YNP ,USFS,

00212

CRAIGHEAD, J.J.

1984
A DEFINITIVE SYSTEM FOR ANALYSIS OF GRIZZLY BEAR HABITAT AND OTHE
R WILDERNESS RESOURCES.

PP. 153-162 IN: P.H. OEHSER, J.S. LEA AND N.L. POWARS, EDS. NATIO
NAL GEOGRAPHIC SOCIETY RESEARCH REPORTS, 1975, VOL. 16. NATL. GEO
GR. SOC., WASHINGTON, D.C.

HAB EFFECT MAP/TYPE FOOD

NCDE,MT ,FLNF,LCNF,LSWA

00213

CRAIGHEAD, J.J. AND F.C. CRAIGHEAD, JR.

1967
MANAGEMENT OF BEARS IN YELLOWSTONE NATIONAL PARK.

MONT. COOP. WILDL. RES. UNIT, UNIV. MONT., MISSOULA. 113 PP.

DISTR	HUMAN INJ	ZONING	GARB MGMT
RECR MGMT	HARV MGMT	DEMOG ANAL	CONTROL
DEPRED			

YGBE,IMW ,YNP ,USFS,

00214

CRAIGHEAD, J.J. AND F.C. CRAIGHEAD, JR.

1970
FOOD HABITS OF YELLOWSTONE GRIZZLY BEARS.

UNPUBL. REP., 35 PP.

FOOD

YGBE,IMW ,YNP , ,

00215

CRAIGHEAD, J.J. AND F.C. CRAIGHEAD, JR.

1972
GRIZZLY BEAR-MAN RELATIONSHIPS IN YELLOWSTONE NATIONAL PARK.

INT. CONF. BEAR RES. AND MANAGE. 2:304-332.

TERR/SPACE	MOVE	POP DENS	GARBAGE
CONTROL	HUMAN INJ	RELOC	GARB MGMT
CAMP MGMT			

YGBE,IMW ,YNP , ,

00216

CRAIGHEAD, J.J., F.C. CRAIGHEAD AND D.J. CRAIGHEAD.

1986
USING SATELLITES TO EVALUATE ECOSYSTEMS AS GRIZZLY BEAR HABITAT.

PP. 101-112 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-G
RIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTA
IN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

MAP/TYPE

,GEN , , ,

00217

CRAIGHEAD, J.J., F.C. CRAIGHEAD, JR. AND M. HORNOCKER.

1962
AN ECOLOGICAL STUDY OF THE GRIZZLY BEAR.

FOURTH ANNUAL REP., SUMMARY OF WORK ACCOMPLISHED 1959-1962. MONT. COOP. WILDL. RES. UNIT, MONT. STATE UNIV., MISSOULA. 38 PP.

RES TECH	POP BIOL	POP EST	MORPH/PHYS
HEMAT	MEAS/QUANT	INTRASP BEH	DISTR
MOVE			

YGBE,WY ,YNP , ,

00218

CRAIGHEAD, J.J., F.C. CRAIGHEAD, JR. AND H.E. MCCUTCHEN.

1970
AGE DETERMINATION OF GRIZZLY BEARS FROM FOURTH PREMOLAR TOOTH SEC TIONS.

J. WILDL. MANAGE. 34(2):353-363.

AGE DETERM	GROW/DEV	DRUGS	MORPH/PHYS

,GEN , , ,

00219

CRAIGHEAD, J.J., F.C. CRAIGHEAD JR. AND R.L. RUFF.

1964
AN ECOLOGICAL STUDY OF THE GRIZZLY BEAR: SIXTH ANNUAL REPORT, SUM MARY OF WORK ACCOMPLISHED, 1964.

MONT. COOP. WILDL. RES. UNIT, MONT. STATE UNIV., MISSOULA. 18 PP.

RES TECH	MOVE	FOOD	CENSUS/TREND
AGE/SEX	REP RATE	MORT DATA	AGE DETERM
MORPH/PHYS			

YGBE,WY ,YNP , ,

00220

CRAIGHEAD, J.J., F.C. CRAIGHEAD, JR. AND J. SUMNER.

1976
REPRODUCTIVE CYCLES AND RATES IN THE GRIZZLY BEAR, URSUS ARCTOS H ORRIBILIS, OF THE YELLOWSTONE ECOSYSTEM.

INT. CONF. BEAR RES. AND MANAGE. 3:337-356.

BRD AGE	LITR FREQ	REP RATE	LITR SIZE
POP REG			

YGBE,IMW ,YNP , ,

00221

CRAIGHEAD, J.J., M.G. HORNOCKER AND F.C. CRAIGHEAD, JR.

1969
REPRODUCTIVE BIOLOGY OF YOUNG FEMALE GRIZZLY BEARS.

J. REPROD. FERT. (SUPPL. 6):447-475.

COURT　　REPRO PHYS　　BRD AGE　　LITR SIZE
LITR FREQ

YGBE,WY ,YNP , ,

00222

CRAIGHEAD, J.J., M.G. HORNOCKER, W. WOODGERD AND F.C. CRAIGHEAD, JR
.
1960
TRAPPING, IMMOBILIZING, AND COLOR-MARKING GRIZZLY BEARS.

TRANS. NORTH AM. WILDL. AND NAT. RESOUR. CONF. 25:347-363.

HIST ACCT　　DRUGS　　WEIGHT　　CAPTURE
RES TECH

YGBE,WY ,YNP , ,

00223

CRAIGHEAD, J.J. AND J.A. MITCHELL.

1982
GRIZZLY BEAR (URSUS ARCTOS).

PP. 515-556 IN: J.A. CHAPMAN AND G.A. FELDHAMER, EDS. WILD MAMMAL
S OF NORTH AMERICA: BIOLOGY MANAGEMENT, ECONOMICS. HOPKINS, BALTI
MORE, MD.

GEN BIOL　　GEN DATA　　DEMOG ANAL　　POP DENS
RES TECH　　MGMT GEN　　DEN　　PARAS/DIS
TAXON/EVOL
YGBE,IMW ,YNP , ,

00224

CRAIGHEAD, J.J. AND D.S. STOCKSTAD.

1960
COLOR MARKER FOR BIG GAME.

J. WILDL. MANAGE. 24(4):435-438.

RES TECH

,GEN , , ,

00225

CRAIGHEAD, J.J., J.S. SUMNER AND G.B. SCAGGS.

1982
A DEFINITIVE SYSTEM FOR ANALYSIS OF GRIZZLY BEAR HABITAT AND OTHE
R WILDERNESS RESOURCES.

WEST. WILDLANDS INST. UNIV. MONT. FOUNDATION, UNIV. MONT., MISSOU
LA. MONOGR. NO. 1. 279 PP.

MAP/TYPE	FOOD	HAB USE	TIMB MGMT
NUTR ANAL	MGMT GEN	HAB EFFECT	FEED BEH

NCDE,MT ,FLNF,LCNF,LSWA

00226

CRAIGHEAD, J.J., J. VARNEY AND F.C. CRAIGHEAD, JR.

1973
COMPUTER ANALYSIS OF THE YELLOWSTONE GRIZZLY BEAR POPULATION.

MONT. COOP. WILDL. RES. UNIT, UNIV. MONT., MISSOULA. 146 PP.

DEMOG ANAL	POP EST	AGE/SEX	REP RATE
LONGEV	MORT RATE	CONTROL	HARV DATA
MGMT GEN			

YGBE,IMW ,YNP ,USFS,

00227

CRAIGHEAD, J.J., J.R. VARNEY AND F.C. CRAIGHEAD, JR.

1974
A POPULATION ANALYSIS OF THE YELLOWSTONE GRIZZLY BEARS.

MONT. COOP. WILDL. RES. UNIT, UNIV. MONT., MISSOULA. BULL. NO. 40
. 20 PP.

DEMOG ANAL	AGE/SEX	REP RATE	MORT RATE
MORT RATE	POP EST	POP REG	MGMT GEN
LONGEV			

YGBE,IMW ,YNP , ,

00228

CRAIGHEAD, J.J., J.R. VARNEY, F.C. CRAIGHEAD, JR. AND J.S. SUMNER.

1976
TELEMETRY EXPERIMENTS WITH A HIBERATING BLACK BEAR.

INT. CONF. BEAR RES. AND MANAGE. 3:357-371.

TELEM	HIB PHYS	TEMP	WEIGHT

,GEN , , ,

00229

CROOK. J. L.

1971
DETERMINATION OF ABUNDANCE AND DISTRIBUTION OF BROWN BEAR (URSUS ARCTOS) NORTH OF THE BROOKS RANGE, ALASKA.

M.S. THESIS, UNIV. ALASKA, FAIRBANKS. 78 PP.

CENSUS METH	CENSUS/TREND	POP DENS	PRES DISTR
FOOD	SEAS BEH	AGE/SEX	REP RATE
HARV DATA			

ARC ,AK , , ,NSLP

00230

CROOK. J. L.

1972
GRIZZLY BEAR SURVEY AND INVENTORY.

FED. AID WILDL. REST. PROJ. W-17-38, JOB 4. JOB COMPLETION REP., JAN. 1, 1970-DEC. 31, 1971. ALASKA DEP. FISH AND GAME, JUNEAU. 38 PP.

HARV DATA	PRES DISTR	SEAS BEH	FOOD
POP DENS		PRED	RES TECH

AK-I,AK , , ,NSLP

00231

CUMBAA, S.L. AND J.V. SCISCENTI.

1978
NOTES ON SIX CRANIA OF THE GRIZZLY BEAR, URSUS ARCTOS, FROM THE CYPRESS HILLS REGION OF SASKATCHEWAN AND ALBERTA.

J. MAMMAL. 59(2):431-433.

DISTR	SKULL

,ATSA, , ,CYPR

00232

CURATOLO, J.A. AND G.D. MOORE.

1975
HOME RANGE AND POPULATION DYNAMICS OF GRIZZLY BEAR IN THE EASTERN BROOKS RANGE, ALASKA.

CHAPTER 1, 79 PP. IN: R. D. JAKIMCHUK, ED. STUDIES OF LARGE MAMMALS ALONG THE PROPOSED MACKENZIE VALLEY GAS PIPELINE ROUTE FROM ALASKA TO BRITISH COLUMBIA. ARCTIC GAS BIOL. REP. SER. VOL. 32.

HOME RNG	DEN	HAB USE	POP DENS
POP BIOL	SEAS BEH	WEIGHT	MEAS/QUANT

ARC ,AK , , ,EBRK

00233

CUSHING, B. S.

1983
RESPONSES OF POLAR BEARS TO HUMAN MENSTRUAL ODORS.

INT. CONF. BEAR RES. AND MANAGE. 5:270-274.

AVOID/ATTRAC

,GEN , , ,

00234

DALLE-MOLLE, J.

1984
FIELD TESTS AND USERS' OPINIONS OF BEAR RESISTANT BACKPACK FOOD C
CNTAINERS IN DENALI NATIONAL PARK, ALASKA, 1982 AND 1983.

U.S.D.I., NATL. PARK SERV., DENALI NATL. PARK, ALASKA. 25 PP.

CAMP MGMT

AK-I,AK ,DENP, ,

00235

DALLE-MOLLE, J.

1984
DETERRING BEARS FROM BACKCOUNTRY CAMPSITES: TESTS IN DENALI NATIO
NAL PARK IN 1984.

PRES. 1ST ALASKA INTERAGENCY BEAR BIOL. CONF. AND WORKSHOP, 5-6 D
ECEMBER 1984. 1 PP.

DETER/REPEL AVER COND

AK-I,AK ,DENP, ,

00236

DALLE-MOLLE, J., M.A. COFFEY AND H.W. WERNER.

IN PRESS
EVALUTION OF BEAR-RESISTANT FOOD CONTAINERS FOR BACKPACKERS.

U.S.D.A., FOREST SERV., INTERMOUNTAIN FOREST AND RANGE EXP. STAT.
, OGDEN, UT. GEN. TECH. REP.

NONMOT MGMT CAMP MGMT DETER/REPEL

AK-I,AK ,DENP, ,

00237

DARLING, L.M.

IN PRESS
HABITAT USE BY GRIZZLY BEAR FAMILY GROUPS IN INTERIOR ALASKA.

INT. CONF. BEAR RES. AND MANAGE. 7.

HAB USE FOOD MOVE

AK-I,AK ,DENP, ,

00238

DASMANN, R.F.

1969
APPARENT EXTINCTION OF GRIZZLY BEAR IN MEXICO.

BIOL. CONSERV. 1(4):336-337.

PRES DISTR

,MEX , , ,

00239

DAVEY, J.T.

1971
A CASE OF ANISAKIS SP. INFECTION IN A BROWN BEAR FROM ALASKA.

TRANS. ROYAL SOC. TROP. MED. AND HYG. 65(4):433-434.

PARAS/DIS

,GEN , , ,

00240

DAVIS, D.D.

1964
THE GIANT PANDA, A MORPHOLOGICAL STUDY OF EVOLUTIONARY MECHANISMS
.

FIELDIANA ZOOL. MEM., VOL. 3. CHICAGO NAT. HIST. MUS., CHICAGO.

MORPH/PHYS

,GEN , , ,

00241

DAVIS, D.L., W.E. MELQUIST AND D. GRAHAM.

1986
THE SELWAY-BITTERROOT ECOSYSTEM AS GRIZZLY BEAR HABITAT.

PP. 158-162 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

MGMT GEN FIRE MGMT

SBE ,ID , , ,

00242

DAVIS, J.L. AND P. VALKENBURG.

1981
NATURAL MORTALITY OF WESTERN ARCTIC CARIBOU.

FED. AID WILDL. REST. PROJ. W-21-1, JOB 3.24R. PROG. REP, JULY 1, 1979-JUNE 30, 1980. ALASKA DEP. FISH AND GAME, JUNEAU. 19 PP.

PRED

ARC ,AK , , ,WBRK

00243

DAVIS, J.L. AND P. VALKENBURG.

1985
QUALITATIVE AND QUANTITATIVE ASPECTS OF NATURAL MORTALITY OF THE WESTERN ARCTIC CARIBOU HERD.

FED. AID WILDL. REST. PROJ. W-17-11, W-21-2, W-22-1, W-22-2 AND W-22-3, JOB 3.24R FINAL REP., JULY 1, 1981- JUNE 30, 1984. ALASKA DEP. FISH AND GAME, JUNEAU. 71 PP.

PRED

ARC ,AK , , ,WBRK

00244

DAVIS, M.

1950
HYBRIDS OF THE POLAR AND KODIAK BEAR.

J. MAMMAL. 31(4):449-450.

REPRO GENETICS

,GEN , , ,

00245

DAY, G., C. JONKEL AND T. WERNER.

1978
RELOCATIONS OF GRIZZLIES IN THE BORDER GRIZZLY AREA.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 14. 7 PP.

RELOC CONTROL

NCDE,MT , , ,

00246

DEAN, F.C.

1958
INVESTIGATIONS ON GRIZZLY BEARS IN INTERIOR AND ARCTIC ALASKA.

ALASKA COOP. WILDL. RES. UNIT QUART. REP. 9(4):61-71.

CENSUS METH CENSUS/TREND POP DENS MOVE
AGE/SEX BEHAV PATT FOOD HAB USE
LITR SIZE
AK-I,AK ,DENP, ,

00247

DEAN, F.C.

1962
INVESTIGATICNS ON GRIZZLY BEARS IN INTERICR AND ARCTIC ALASKA.

ALASKA COOP. WILDL. RES. UNIT QUART. REP. 14(1):9-16.

CAPTURE DRUGS

AK-I,AK , , ,

00248

DEAN, F.C.

1968
BROWN BEAR - HUMAN INTERRELATIONSHIP STUDY.

U.S.D.I., NATL. PARK SERV., KATMAI NATL. MONUMENT, ALASKA. FINAL REP. CONTRACT NPS PO 126-301. 39 PP.

FOOD PRED POP EST
RECR MGMT PUBLIC ATT REACTION POL/ADM MGMT
GARB MGMT
AKPN,AK ,KANM, ,BROO

00249

DEAN, F.C.

1975
A LAND USE PHILOSOPHY PROPOSAL FOR BEAR MANAGEMENT.

PRES. AT NORTHWEST. SECT. WILDL. SOC. MEET., 4 APRIL 1975, ANCHOR
AGE, ALASKA. 20 PP.

POACH/ILLEG	MGMT GEN	RECR MGMT	POL/ADM MGMT
LEGAL	GARB MGMT	ZONING	

,AK , , ,

00250

DEAN, F.C.

1976
ASPECTS OF GRIZZLY BEAR POPULATION ECOLOGY IN MOUNT MCKINLEY NATI
ONAL PARK.

INT. CONF. BEAR RES. AND MANAGE. 3:111-119.

POP DENS	AGE/SEX	LITR SIZE	COURT
RECR IMP	HARV DATA		

AK-I,AK ,DENP, ,

00251

DEAN, F.C., L.M. DARLING AND A.G. LIERHAUS.

1985
OBSERVATIONS OF INTRASPECIFIC KILLING BY BROWN BEAR (URSUS ARCTOS
).

CAN. FIELD-NAT. 99.

CANNIBAL

AK-I,AK ,DENP, ,

00252

DEAN, F.C. AND I.F. GRESEHOVER.

1983
BROWN BEAR BIBLIOGRAPHY: SUPPLEMENT NO. 1.

ALASKA COOP. PARK STUDIES UNIT, UNIV. ALASKA, FAIRBANKS.

BIBLIO

,GEN , , ,

00253

DEAN, F.C.

IN PRESS
BROWN BEAR DENSITY IN DENALI NATIONAL PARK, ALASKA: SIGHTING EFF
ICIENCY TECHNIQUES.

INT. CONF. BEAR RES. AND MANAGE. 7.

POP DENS CENSUS METH

AK-I,AK ,DENP, ,

00254

DELLINGER, P. (ED.)

1985
INDENITIFICATION MANUAL VOLUME I: MAMMALIA.

CONVENTION INT. TRADE ENDANGERED SPECIES WILD FAUNA AND FLORA.

IDENT/RECOG

,GEN , , ,

00255

DELSORDO, D.

1981
A REVIEW OF LITERATURE RELATED TO WHITE PINE BLISTER RUST, WHITE
BARK PINE, AND GRIZZLY BEARS.

B.S. THESIS, UNIV. MONT., MISSOULA. 20 PP.

FOOD HAB USE MGMT GEN

,GEN , , ,

00256

DEMARCHI, R.A.

1981
PROTECTING FEMALE AND JUVENILE GRIZZLY BEARS FROM HUNTING MORTALI
TY.

B.C. FISH AND WILDL. BRANCH, VICTORIA. 3 PP.

HARV IMP HARV MGMT

,BC , , ,

00257

DEMASTER, D.P., M.C.S. KINGSLEY AND I. STIRLING.

1980
A MULTIPLE MARK AND RECAPTURE ESTIMATE APPLIED TO POLAR BEARS.

CAN. J. ZOOL. 58:633-638.

CENSUS METH

,GEN , , ,

00258

DEROCHER, A.E. AND J.S. MILLER

1986
BEAR DETERRENT STUDY (TWELVE GAUGE FERRET SHELL TESTS) CAPE CHURC
HILL, MANITOBA, 1984.

GOV. OF NORTHWEST TERRIT., DEP. RENEWABLE RESOUR., YELLOWKNIFE. R
EP. NO. 54. 40 PP.

DETER/REPEL

,GEN , , ,

00259

DESPAIN, D.G.

1986
HABITAT TYPE AND COVER TYPE AS A BASE FOR GRIZZLY BEAR HABITAT MA
PPING AND EVALUATION.

PP. 230-233 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-G
RIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTA
IN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

TYPE DESCRIP MAP/TYPE

YGBE,IMW , , ,

00260

DIDRICKSON, J.C. AND K.P. TAYLOR.

1978
LOWER SUSITNA VALLEY MOOSE POPULATION IDENTITY STUDY.

FED. AID WILDL. REST. PROJ. W-17-8 AND W-17-9, JOB 1.16R. FINAL R
EP. ALASKA DEP. FISH AND GAME, JUNEAU. 26 PP.

PRED

AK-I,AK , , ,NESU

00261

DOLL, D., W.P. MCCRORY AND J.D. FEIST.

1974
CBSERVATIONS OF MOOSE, WOLF AND GRIZZLY BEAR IN THE NORTHERN YUKO
N TERRITORY.

CHAP. 3 IN: K.H. MCCOURT AND L.P. HORSTMAN, EDS. STUDIESOF LARGE MAMMAL POPULATIONS IN NORTHERN ALASKA, YUKON AND NORTHWEST TERRIT ORIES, 1973. ARCTIC GAS. BIOL. REP. SER. VOL. 22.

PRES DISTR	PELAGE	AGE/SEX	LITR SIZE
DEN CHRON	AIRCRAFT IMP		

CARC,YK , , ,

00262

DOOD, A.R., R.D. BRANNON AND R.D. MACE.

1986
FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT: THE GRIZZLY B
EAR IN NORTHWESTERN MONTANA.

MONT. DEP. FISH, WILDL. AND PARKS, HELENA. 287 PP.

HARV IMP	HARV DATA	HARV MGMT	POP BIOL
MORT RATE	DEMOG ANAL	MGMT PLAN	GEN DATA
RECR MGMT			

NCDE,MT , , ,

00263

DOOD, A.R., R.D. BRANNON AND R.D. MACE.

IN PRESS
MANAGEMENT OF GRIZZLY BEARS IN THE NORTHERN CONTINENTAL DIVIDE EC
OSYSTEM, MONTANA.

TRANS. NORTH AM. WILDL. NAT. RESOUR. CONF. 51.

HARV MGMT	HARV DATA	HARV IMP	MGMT GEN
POP BIOL	POACH/ILLEG	MORT DATA	ROAD IMP
DEPRED			

NCDE,MT , , ,

00264

DORRANCE, M.J. AND B.K. GILBERT.

1977
CONSIDERATIONS IN THE APPLICATION OF AVERSIVE CONDITIONING.

PP. 136-144 IN: W.B. JACKSON AND R.E. MARSHA, EDS. TEST METHODS F OR VERTEBRATE PEST CONTROL AND MANAGEMENT MATERIALS. AM. SOC. FOR TESTING AND MATERIALS. SPEC. TECH. PUBL. 625.

AVER COND

,GEN , , ,

00265

DORRANCE, M.J. AND L.D. ROY.

1978
AVERSIVE CONDITIONING TESTS OF BLACK BEARS IN BEEYARDS FAILED.

PROC. VERTEBR. PEST CONF. 8:251-254.

AVER COND

,GEN , , ,

00266

DOUGLASS, R.J., J.M. WRIGHT, S.G. FANCY, E.H. FOLLMAN, J.L. HECHTEL
.
1980
ASSESSMENT OF THE KNOWLEDGE OF POTENTIAL EFFECTS OF THE NORTHWEST ALASKAN PIPELINE PROJECT ON MAMMALS: LITERATURE REVIEW AND AGENCY INPUT.

PREP. FOR NORTHWEST ALASKAN PIPELINE CO., CONTRACT 478085-9-K071 BY LGL ECOL. RES. ASSOC., INC. AND UNIV. ALASKA, FAIRBANKS. 150 PP.

ENERGY IMP ROAD IMP GARBAGE HUMAN IMP

,AK , , ,

00267

DOWNING, C.

1975
WILDLIFE ACTIVITY AT THE MCKINLEY PARK AREA GARBAGE DUMPS. A GUIDE FOR MANAGEMENT.

REP. PREP. FOR U.S.D.I., NATL. PARK SERV., DENALI NATL. PARK AND PRESERVE, ALASKA. PREP. BY ALASKA COOP. PARK STUDIES, UNIV. ALASKA, FAIRBANKS. 67 PP.

GARBAGE GARB MGMT

AK-I,AK ,DENP, ,

00268

DRABELLE, D.

1985
THE ENDANGERED SPECIES PROGRAM.

PP. 73-90 IN: R.L. DISILVESTRO, ED. AUBUDON WILDLIFE REPORT 1985. NATL. AUDUBON SOC., N.Y.

LEGAL

,US , , ,

C0269

DUFF, S.

1980
KAH MOUNTAIN INVESTIGATIONS.

PP. 205-216 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ
., UNIV. MONT., MISSOULA. ANNU. REP. NO. 5.

PRES DISTR HAB USE

NCDE,MT , , ,SFLT

C0270

DUNCAN, M.P.

1978
FORMAL SECTION 7 CONSULTATION REGARDING THE POTENTIAL EFFECT OF G
EOTHERMAL LEASING WITHIN THE TARGHEE AND GALLATIN NATIONAL FOREST
S.

U.S.D.I., FISH AND WILDL. SERV., DENVER, COLO. 3 PP.

ENERGY IMP

YGBE,IDMT,TANF,GANF,ISLP

00271

EAGLE, T.C. AND M.R. PELTON.

1983
SEASONAL NUTRITION OF BLACK BEARS IN THE GREAT SMOKY MOUNTAINS NA
TIONAL PARK.

INT. CONF. BEAR RES. AND MANAGE. 5:94-101.

NUTR ANAL NUTR

,GEN , , ,

00272

EBERHARDT, L.L., R.R. KNIGHT AND B.M. BLANCHARD.

1986
MONITORING GRIZZLY BEAR POPULATION TRENDS.

J. WILDL. MANAGE. 50(4):613-618.

MORT DATA DEMOG ANAL CENSUS/TREND

YGBE,IMW , , ,

00273

EDGE, W.D.

IN PRESS
ESTIMATING CARRYING CAPACITY OF GRIZZLY BEAR POPULATIONS.

DRAFT REP. PREP. FOR U.S. FISH AND WILDL. SERV., OFFICE OF GRIZZL
Y BEAR RECOVERY COORDINATOR, MISSOULA, MONT. 16 PP.

MIN POP   POP REG

,GEN ,   ,   ,

00274

EDWARDS, R.Y. AND D.E. GREEN.

1959
THE MEASUREMENT OF TRACKS TO CENSUS GRIZZLY BEARS.

MURRELET 40(2):14-16.

CENSUS METH

BC-C,BC ,   ,   ,

00275

EGBERT, A.L.

1978
THE SOCIAL BEHAVIOR OF BROWN BEARS AT MCNEIL RIVER, ALASKA.

PH.D. DISS., UTAH STATE UNIV., LOGAN. 117 PP.

FEED BEH   TERR/SPACE   THREAT   VOCAL
AGON   INTRASP BEH   MATERNAL   COURT
PRED
AKPN,AK ,   ,   ,MCNE

00276

EGBERT, A.L. AND A.W. STOKES.

1976
THE SOCIAL BEHAVIOUR OF BROWN BEARS ON AN ALASKAN SALMON STREAM.

INT. CONF. BEAR RES. AND MANAGE. 3:41-56.

TERR/SPACE   AGE/SEX   THREAT   AGON
INTRASP BEH   ACT PATT   MATERNAL

AKPN,AK ,MCGS,   ,MCNE

00277

EGGERS, D.E.

1986
MANAGEMENT OF WHITEBARK PINE AS POTENTIAL GRIZZLY BEAR HABITAT.

PP. 170-175 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

TIMB MGMT FIRE MGMT

,GEN , , ,

00278

EIDE, S.

1965
THE NATURE OF BROWN BEAR PREDATION ON CATTLE, KODIAK ISLAND, ALASKA.

PROC. ANNU. CONF. WEST. ASSOC. STATE GAME AND FISH COMMISSIONERS 45:113-118.

DEPRED CONTROL AGE/SEX

AKKA,AK , , ,

00279

ELGMORK, K.

1978A
HUMAN IMPACT ON A BROWN BEAR POPULATION (URSUS ARCTOS L.).

BIOL. CONSERV. 13(2):81-103.

ROAD IMP TIMB IMP HUMAN IMP

,GEN , , ,

C0280

ELGMORK, K.

1978B
STRIKING BLOWS BY THE BROWN BEAR. (ENGLISH SUMMARY)

FAUNA 31:157-164.

PRED

,GEN , , ,

00281

ELGMORK, K.

1982
CACHING BEHAVIOR OF BROWN BEARS (URSUS ARCTOS).

J. MAMMAL. 63(4):607-612.

PRED FEED BEH CARCASS

,GEN , , ,

00282

ELGMORK, K.

1983
INFLUENCE OF HOLIDAY CABIN CONCENTRATIONS ON THE OCCURRENCE OF BR
OWN BEARS (URSUS ARCTOS L.) IN SOUTH-CENTRAL NORWAY.

ACTA ZOOL. FENNICA 174:161-162.

URBAN DEV

,GEN , , ,

00283

ELTON, C.S.

1954
FURTHER EVIDENCE ABOUT THE BARREN GROUND GRIZZLY BEAR IN NORTHEAS
T LABRADOR AND QUEBEC.

J. MAMMAL. 35(3):345-357.

HIST DISTR

,ECAN, , ,

00284

ENDERS, A.C.

1963
DELAYED IMPLANTATION.

UNIV. CHICAGO PRESS, CHICAGO. 318 PP.

REPRO PHYS

,GEN , , ,

00285

ERICKSON, A.W.

1960
BROWN BEAR STUDIES, ALASKA PENINSULA.

PP. 301-312 IN: GAME INVESTIGATIONS OF ALASKA. FED. AID WILDL. REST. PROJ. W-6-R-1, JOB NO. 1, WORK PLAN F. ANNU. REP., VOL. 1. JULY 10, 1959-AUGUST 30, 1959. ALASKA DEP. FISH AND GAME, JUNEAU.

AGE/SEX LITR SIZE CENSUS/TREND

AKPN,AK , , ,

C0286

ERICKSON, A.W.

1961
BROWN BEAR STUDIES, ALASKA PENINSULA.

PP. 1-9 IN: ALASKA WILDLIFE INVESTIGATIONS. FED. AID WILD. REST. PROJ. W-6-R-2, JOB NO. 1, WORK PLAN F. ANNU. REP., VOL. 2, MAY 10 -OCT. 13, 1960. ALASKA DEP. FISH AND GAME, JUNEAU.

AGE/SEX LITR SIZE CENSUS/TREND

AKPN,AK , , ,

00287

ERICKSON, A.W.

1962A
BROWN BEAR STUDIES, ALASKA PENINSULA.

FED. AID WILDL. REST. PROJ. W-6-R-3, JOB 1-A, WORK PLAN F. AUGUST 6-25, 1961. ALASKA DEP. FISH AND GAME, JUNEAU. 6 PP.

AGE/SEX REP RATE LITR SIZE CENSUS/TREND

AKPN,AK , , ,

00288

ERICKSON, A.W.

1962B
CHARACTERISTICS OF THE BROWN AND GRIZZLY BEAR HARVEST.

FED. AID WILDL. REST. PROJ. W-6-R-3, JOB 2, WORK PLAN F. SEPT. 1, 1961-JUNE 30, 1962. ALASKA DEP. FISH AND GAME, JUNEAU. 11 PP.

HARV DATA AGE/SEX MISC QUANT SKULL

,AK , , ,

00289

ERICKSON, A.W.

1963
1962-63 REPORT ON BEARS.

FED. AID WILDL. REST. PROJ. W-6-R-4, JOB NOS. 1, 2-A, 2-B, 3, 4. WORK PLAN F. JULY 1, 1962-JUNE 30, 1963. ALASKA DEP. FISH AND GAME, JUNEAU. 32 PP.

ACT PATT BEHAV PATT CENSUS METH HARV DATA
AGE/SEX MISC QUANT SKULL

,AK , , ,

00290

ERICKSON, A.W.

1964
A MIXED-AGE LITTER OF BROWN BEAR CUBS.

J. MAMMAL. 45(2):312-313.

MATERNAL WEAN

AKPN,AK , , ,AMER

00291

ERICKSON, A.W.

1965
THE BROWN-GRIZZLY BEAR IN ALASKA. ITS ECOLOGY AND MANAGEMENT.

FED. AID WILDL. REST. PROJ. W-6-R-5, WORK PLAN F. VOL. V. ALASKA DEP. FISH AND GAME, JUNEAU. 42 PP.

GEN BIOL INTRASP BEH HARV DATA CENSUS METH
POP BIOL DEN MEAS/QUANT MGMT GEN
PELAGE
,AK , , ,

00292

ERICKSON, A.W.

1974
EVALUATION OF THE GILA WILDERNESS FOR RE-ESTABLISHMENT OF THE GRIZZLY BEAR.

U.S.D.A., GILA NATL. FOREST, SILVER CITY, N.M. 40 PP.

HIST DISTR HAB RECON LIVESTK IMP INT/REINT

GINF,NM , , ,GIWA

00293

ERICKSON, A.W.

1975
GRIZZLY BEAR MANAGEMENT IN THE SEELEY LAKE RANGER DISTRICT.

U.S.D.A., FOREST SERV., LOLO NATL. FOREST, MONT. F.S. PUBL. NO. R 1-75-003. 30 PP.

DISTR	HAB RECON	TIMB-METH	TIMB MGMT
HARV MGMT	MGMT GEN	CENSUS/TREND	

NCDE,MT ,LONF, ,SEEL

00294

ERICKSON, A.W.

1976
GRIZZLY BEAR MANAGEMENT IN THE THOMPSON FALLS AREA AND ADJACENT E NVIRONS.

U.S.D.A., FOREST SERV., LOLO NATL. FOREST AND KOOTENAI NATL. FORE ST, MONT. F.S. PUBL. NO. R1-76002. 58 PP.

HIST DISTR	HARV DATA	PRES DISTR	HAB RECON
ROAD IMP	MGMT GEN	ZONING	TIMB-METH

CYE ,MT ,KONF,LONF,

00295

ERICKSON, A.W.

1977
CABINET MOUNTAINS GRIZZLY BEAR MANAGEMENT STUDY.

U.S.D.A., FOREST SERV. CONTRACT NO. 262-46. 25 PP.

HAB RECON	DISTR		TIMB MGMT
ROAD IMP	TIMB IMP	ROAD MGMT	ENERGY IMP
MGMT GEN			

CYE ,MT , , ,

00296

ERICKSON, A.W.

1978
GRIZZLY BEAR MANAGEMENT IN THE CABINET MOUNTAIN OF WESTERN MONTAN A.

U.S.D.A., FOREST SERV. CONTRACT NO. 262-46. 82 PP.

HAB RECON	ROAD MGMT	FIRE MGMT	ENERGY IMP
TIMB MGMT	MGMT GEN	ROAD IMP	

CYE ,MT ,USFS, ,

00297

ERICKSON, A.W. AND L.H. MILLER.

1963
CUB ADOPTION OF THE BROWN BEAR.

J. MAMMAL. 44(4):584-585.

INTRASP BEH   MATERNAL   AGON

AKPN,AK ,   ,   ,MCNE

00298

ERICKSON, A.W., H.W. MOSSMAN, R.J. HENSEL AND W.A. TROYER.

1968
THE BREEDING BIOLOGY OF THE MALE BROWN BEAR (URSUS ARCTOS).

ZOOLOGICA 53(3):85-105.

REPRO PHYS   MISC QUANT   BRD AGE   MORPH/PHYS
AGE DETERM   SKULL   COURT

,GEN ,   ,   ,

00299

ERICKSON, A.W. AND D.B. SINIFF.

1963
A STATISTICAL EVALUATION OF FACTORS INFLUENCING AERIAL SURVEY RES
ULTS ON BROWN BEARS.

TRANS. NORTH AM. WILDL. AND NAT. RESOUR. CONF. 28:391-409.

CENSUS METH

AKPN,AK ,   ,   ,CHIG

00300

ERICKSON, A.W. AND W.G. YOUATT.

1961
SEASONAL VARIATIONS IN THE HEMATOLOGY AND PHYSIOLOGY OF BLACK BEA
RS.

J. MAMMAL. 42(2):198-203.

HIB PHYS   WEIGHT   HEMAT

,GEN ,   ,   ,

00301

ERICKSON, G.L., C.R. WATTS, F.G. FEIST AND J.J. MCCARTHY.

1974
BIG GAME SURVEY AND INVENTORY REGION FOUR - ANTELOPE, MOUNTAIN GO
ATS, BIGHORN SHEEP, MOOSE AND BEAR.

FED. AID WILDL. REST. PROJ. W-130-R-5, JOB I-4. PROG. REP., JULY
1, 1973-JUNE 30, 1974. MONT. DEP. FISH AND GAME, HELENA. 85 PP.

PRES DISTR

NCDE,MT , , ,

00302

ERICKSON, G.L., C.R. WATTS, A.D. SCHALLENBERGER AND F.G. FEIST.

1973
BIG GAME SURVEY AND INVENTORY REGION FOUR - ANTELOPE, MOUNTAIN GO
ATS, BIGHORN SHEEP, MOOSE AND BEAR.

FED. AID WILDL. REST. PROJ. W-130-R-4, JOB I-4. PROG. REP., JULY
1, 1972-JUNE 30, 1973. MONT. DEP. FISH AND GAME, HELENA. 64 PP.

PRES DISTR

NCDE,MT , , ,

00303

EWER, R.F.

1973
THE CARNIVORES.

CORNELL UNIV. PRESS, ITHACA. 494 PP.

MORPH/PHYS DENT PELAGE TERR/SPACE
REPRO PHYS

,GEN , , ,

00304

FANCY, S.G.

1980
PREPARATION OF MAMMALIAN TEETH FOR AGE DETERMINATION BY CEMENTUM
LAYERS: A REVIEW.

WILDL. SOC. BULL. 8(3):242-248.

AGE DETERM

,GEN , , ,

00305

FARO, J.B. AND S.H. EIDE.

1974
MANAGEMENT OF MCNEIL RIVER STATE GAME SANCTUARY FOR NONCONSUMPTIV
E USE OF ALASKAN BROWN BEARS.

PROC. ANNU. CONF. WEST. ASSOC. GAME AND FISH COMMISSIONERS 54:113
-118.

RECR IMP RECR MGMT

AKPN,AK ,MCGS, ,MCNE

00306

FINDLEY, J.S., A.H. HARRIS, D.E. WILSON AND C. JONES.

1975
MAMMALS OF NEW MEXICO.

UNIV. N.M. PRESS, ALBUQUERQUE. 360 PP.

DISTR

,NM , , ,

00307

FINEGAN, R.P.

1970
GRIZZLY BEAR HARVESTS BY RESIDENT HUNTERS, 1965-1969.

B.C. FISH AND WILDL. BRANCH, VICTORIA.

HARV DATA

,BC , , ,

00308

FINEGAN, R.P.

1971
GRIZZLY BEAR HARVESTS BY RESIDENT HUNTERS, 1965-1970.

B.C. FISH AND WILDL. BRANCH, VICTORIA.

HARV DATA

,BC , , ,

C0309

FISHER, A.H.

1922
THE GRIZZLY BEAR AS A TREE CLIMBER.

J. MAMMAL. 3:53.

BEHAV PATT

,GEN , , ,

00310

FLOWERS, R.

1977
THE ART AND TECHNIQUE OF SNARING BEARS.

WASH. FOR. PROT. ASSOC., SEATTLE. 37 PP.

CAPTURE

,GEN , , ,

00311

FOLK, G.E., JR.

1967
PHYSIOLOGICAL OBSERVATICNS OF SUBARCTIC BEARS UNDER WINTER DEN CO
NDITIONS.

PP. 75-85 IN: K. FISHER, A.R. DAWE, C.P. LYMAN, E. SCHONBAUM AND
F.E. SOUTH JR., EDS. MAMMALIAN HIBERNATION III. PROC. 3RD INT. SY
MPOSIUM.,13-16 SEPT. 1965, TORONTO. AMERICAN ELSEVIER PUBL. CO.,
INC., N.Y.

HEART HIB PHYS TEMP

,GEN , , ,

00312

FOLK, G.E., JR.

1980
PROTEIN AND FAT METABOLISM DURING MAMMALIAN HYPOPHAGIA AND HIBERN
ATION.

FED. PROC. 39(12):2953-2954.

HIB PHYS

,GEN , , ,

00313

FOLK, G.E., JR., M.A. FOLK AND W.O. ESSLER.

1971
EXPERIENCES WITH IMPLANTED PHYSIOLOGICAL RADIO-CAPSULES.

PP. 76-77 IN: DIGEST OF PAPERS. PROC. INT. SYMPOSIUM ON BIOTELEME TRY, VOL. VIII-4, 5-8 MAY 1971, NIJMEGEN, NETHERLANDS.

TELEM

,GEN , , ,

00314

FOLK, G.E., JR., M.A. FOLK AND J.J. MINOR.

1972
PHYSIOLOGICAL CONDITIONS OF THREE SPECIES OF BEARS IN WINTER DENS
.

INT. CONF. BEAR RES. AND MANAGE. 2:107-124.

HIB PHYS HEART

,GEN , , ,

00315

FOLK, G.E, JR., J.M. HUNT AND M.A. FOLK.

1980
FURTHER EVIDENCE FOR HIBERNATION OF BEARS.

INT. CONF. BEAR RES. AND MANAGE. 4:43-47.

HIB PHYS HEART TEMP

,GEN , , ,

00316

FOLK, G.E., JR., A.M. LARSON AND M.C. BREWER.

1968A
PHYSIOLOGICAL MEASUREMENTS ON GRIZZLY AND POLAR BEARS IN EXTREME COLD.

PP. 2-6 IN: INT. SYMPOSIUM ALTITUDE AND COLD, PROC. NO. 26, 2-6 S EPT. 1968, ASPEN, COLO. INT. PHYSICL. CONGR.

HIB PHYS HEART

,GEN , , ,

00317

FOLK, G.E., JR., A. LARSON AND M.A. FOLK.

1976
PHYSIOLOGY OF HIBERNATING BEARS.

INT. CONF. BEAR RES. AND MANAGE. 3:373-380.

HEART HIB PHYS

,GEN , , ,

00318

FOLK, G.E., JR. AND R.A. NELSON.

1982
THE HIBERNATION OF POLAR BEARS: A MODEL FOR THE STUDY OF HUMAN STARVATION.

PP. 617-619 IN: B. HARVALD AND J.P. HART HANSEN, EDS. CIRCUMPOLAR HEALTH 81. PROC. 5TH INT. SYMPOSIUM CIRCUMPOLAR HEALTH, 9-13 AUGUST 1981, COPENHAGEN. NORDIC COUNCIL FOR ARCTIC MED. RES. REP. SER. 33.

HIB PHYS

,GEN , , ,

00319

FOLK, G.E., JR., R.C. SIMMONDS, M.C. BREWER AND M.A. FOLK.

1968B
PHYSIOLOGY OF WINTER DENNING OF POLAR AND GRIZZLY BEARS.

PROC. ALASKA SCI. CONF. 9:26-27.

HIB PHYS HEART

,GEN , , ,

00320

FOLK, G.E., JR., R.C. SIMMONDS AND R.S. HEDGE.

1965
TELEMETERED PHYSIOLOGICAL MEASUREMENTS OF SUB-ARCTIC BEARS DURING NATURAL COLD EXPOSURE.

AM. ZOOL. 5(2):239-240.

HEART

,GEN , , ,

00321

FOLLMANN, E.H., R.A. DIETERICH AND J.L. HECHTEL.

1980
RECOMMENDED CARNIVORE CONTROL PROGRAM FOR THE NORTHWEST ALASKAN P
IPELINE PROJECT INCLUDING A REVIEW OF HUMAN-CARNIVORE ENCCUNTER P
ROBLEMS AND ANIMAL DETERRENT METHODOLOGY.

FINAL REP. PREP. FOR NORTHWEST ALASKAN PIPELINE CO. PREP.BY INST.
 OF ARCTIC BIOL., UNIV. ALASKA, FAIRBANKS. 113 PP.

LEGAL	DETER/REPEL	HUMAN INJ	DEPRED
GARBAGE	CONTROL	ENERGY IMP	AVER COND

,AK , , ,

00322

FOLLMANN, E.H., A.E. MANNING AND J.L. STUART.

1982
A LONG RANGE IMPLANTABLE HEART RATE TRANSMITTER FOR FREE-RANGING
ANIMALS.

BIOTELEMETRY PATIENT MONITG. 9:205-212.

TELEM

,GEN , , ,

00323

FOLLMAN, E.H., L.M. PHILO AND H.V. REYNOLDS.

1979
ANNUAL VARIATIONS IN BODY TEMPERATURE OF GRIZZLY BEARS.

PROC. ALASKA SCI. CONF. 29:647.

HIB PHYS	TEMP	TELEM

,GEN , , ,

00324

FORBES, R.B.

1983
GRIZZLY BEAR SPECIES STATEMENT, REGION II.

B.C. FISH AND WILDL. BRANCH, VICTORIA. 5 PP.

MGMT GEN	POP EST	HARV MGMT

BC-C,BC , , ,

00325

FORESMAN, K.R. AND J.C. DANIEL, JR.

1983
PLASMA PROGESTERONE CONCENTRATIONS IN PREGNANT AND NON-PREGNANT B
LACK BEARS (URSUS AMERICANUS).

J. REPROD. FERT. 68(1):235-239.

REPRO PHYS HEMAT

,GEN , , ,

00326

FORTIER, B.G.

1983
BEAR MANAGEMENT AT YELLOWSTONE NATIONAL PARK: EFFECTIVENESS OF IN
FORMATION DISSEMINATION TO VISITORS.

M.S. THESIS, COLO. STATE UNIV., FT. COLLINS. 189 PP.

PUBLIC ATT EDUC RECR MGMT

YGBE,IMW ,YNP , ,

00327

FOSS, A.J.

1963
BIG GAME SURVEYS AND INVESTIGATIONS - ANTELOPE, BIGHORN SHEEP, MO
UNTAIN GOATS AND BEAR.

FED. AID WILDL. REST. PROJ. NO. W-74-R-8, JOB A-1, PART 1. MAY 1,
1962-APRIL 30, 1963. MONT. FISH AND GAME DEP., HELENA. 9 PP.

HARV DATA

NCDE,MT , , ,

00328

FOSS, A.J. AND C.A. WHITNEY.

1966
BIG GAME SURVEYS AND INVESTIGATIONS.

FED. AID WILDL. REST. PROJ. NO. W-75-R-10, JOB A-1. JULY 1, 1964-
JUNE 30, 1965. MONT. FISH AND GAME DEP., HELENA. 34 PP.

HARV DATA

,MT , , ,

00329

FOWLER, C.W.

1981
COMPARATIVE POPULATION DYNAMICS IN LARGE MAMMALS.

PP. 437-455 IN: C.W. FOWLER AND T.D. SMITH, EDS. DYNAMICS IN LARG
E MAMMAL POPULATIONS. JOHN WILEY AND SONS, N.Y.

DEMOG ANAL HARV IMP

,GEN , , ,

00330

FRANKEL, O.H. AND M.E. SOULE.

1981
CONSERVATION AND EVOLUTION.

CAMBRIDGE UNIVERSITY PRESS, CAMBRIDGE. 327 PP.

GENETICS

,GEN , , ,

00331

FRANKLIN, B. AND G. MATEJKO.

1983
GRIZZLY BEAR/LIVESTOCK MONITORING, ISLAND PARK RANGER DISTRICT, T
ARGHEE NATIONAL FOREST, FISCAL YEAR 1983.

U.S.D.A., FOREST SERV., TARGHEE NATL. FOREST, ST. ANTHONY, IDAHO.
6 PP.

LIVESTK IMP DEPRED LIVESTK MGMT

YGBE,ID ,TANF, ,ISLP

00332

FRANZMANN, A.W., A. FLYNN, C.C. SCHWARTZ, D.G. CALKINS AND L. NICHO
LS JR.
1981
BETA-ENDORPHINE LEVELS IN BLOOD FROM SELECTED ALASKAN MAMMALS.

J. WILDL. DIS. 17(4):593-596.

HIB PHYS HEMAT

,GEN , , ,

00333

FRANZMANN, A.W. AND C.C. SCHWARTZ.

1979
KENAI PENINSULA MOOSE CALF MORTALITY STUDY.

FED. AID WILDL. REST. PROJ. W-17-10 AND W-17-11, JOB 1.24R. FINAL REP., JULY 1, 1977-1979. ALASKA DEP FISH AND GAME, JUNEAU. 20 PP.

PRED

AKPN,AK , , ,KENA

00334

FRANZMANN, A.W., C.C. SCHWARTZ AND D.C. JOHNSON.

1983
KENAI PENINSULA MOOSE CALF MORTALITY STUDY.

FED. AID WILDL. REST. PROJ. W-22-1 AND W-22-2, JOB 1.33R. PROGR. REP., VOL. I. ALASKA DEP. FISH AND GAME, JUNEAU. 15 PP.

PRED

AKPN,AK , , ,KENA

00335

FRANZMANN, A.W., C.C. SCHWARTZ AND R.O. PETERSON.

1979
KENAI PENINSULA MOOSE CALF MORTALITY STUDY.

FED. AID WILDL. REST. PROJ. W-17-10 AND W-17-11, JOB 1.24R. FINAL REP., JULY 1, 1977-JUNE 20, 1979. ALASKA DEP. FISH AND GAME, JUNEAU. 20 PP.

PRED

AKPN,AK , , ,KENA

00336

FRANZMANN, A.W., C.G. SCHWARTZ AND R.O. PETERSON.

1980
MOOSE CALF MORTALITY IN SUMMER ON THE KENAI PENINSULA, ALASKA.

J. WILDL. MANAGE. 44(3):764-768.

PRED

AKPN,AK , , ,KENA

00337

FRASER, D.

1976
AN ESTIMATE OF HUNTING MORTALITY BASED ON THE AGE AND SEX STRUCTU
RE OF THE HARVEST.

PROC. NORTH AM. MOOSE CONF. 12:236-273.

CENSUS METH HARV MGMT AGE/SEX

,GEN , , ,

00338

FRASER, D.

1984
A SIMPLE RELATIONSHIP BETWEEN REMOVAL RATE AND AGE-SEX COMPOSITIO
N OF REMOVALS FOR CERTAIN ANIMAL POPULATIONS.

J. APPL. ECOL. 21:97-101.

CENSUS METH AGE/SEX HARV MGMT

,GEN , , ,

00339

FRASER, D., J.F. GARDNER, G.B. KOLENOSKY AND S. STRATHEARN.

1982
ESTIMATION OF HARVEST RATE OF BLACK BEARS FROM AGE AND SEX DATA.

WILDL. SOC. BULL. 10(1):53-57.

AGE/SEX HARV MGMT CENSUS METH

,GEN , , ,

C0340

FREEMAN-HAET, M.F.

1973
GLACIER NATIONAL PARK VISITOR IMAGES OF GRIZZLY BEARS.

M.S. PAPER, MICH. STATE UNIV., LANSING. 29 PP.

PUBLIC ATT

NCDE,MT ,GLNP, ,

00341

FREIHEIT, C.F. AND M.J. CROTTY.

1969
HAND REARING KODIAK BEARS.

INT. ZOO YEARB. 9:158-160.

ZOO TECH

,GEN , , ,

00342

FROST, J.R.

1985
LIVING WITH THE GRIZZLY: PERCEPTIONS OF MISSION VALLEY RESIDENTS.

M.S. THESIS, UNIV. MONT., MISSOULA. 96 PP.

PUBLIC ATT DEPRED EDUC

NCDE,MT ,FLIR,USFS,MISS

00343

FUJINO, K.K.

1984(?)
OMINECA GRIZZLY BEAR STATUS REPORT.

B.C. FISH AND WILDL. BRANCH, VICTORIA. 7 PP.

HARV DATA AGE/SEX HARV MGMT HARV IMP

CR ,BC , , ,OMIN

00344

FUJINO, K.K. AND K.N. CHILD.

1985(?)
GRIZZLY BEAR MANAGEMENT AND HARVEST RECOMMENDATIONS FOR M.U.'S 7-16, 7-17 AND 7-23 IN THE OMINECA.

B.C. FISH AND WILDL. BRANCH, VICTORIA. 8 PP.

POP EST POP DENS HARV IMP HARV MGMT
HARV DATA

CR ,BC , , ,OMIN

00345

GARCIA, E.R.

1986
GRIZZLY BEAR DIRECT HABITAT IMPROVEMENT ON THE KOOTENAI NATIONAL FOREST.

PP. 185-189 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERVICE. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

TIMB-METH TIMB-HAB TIMB-POST FIRE MGMT

CYE ,MT ,KONF, ,

00346

GARD, R.

1971
BROWN BEAR PREDATION ON SOCKEYE SALMON AT KARLUK LAKE, ALASKA.

J. WILDL. MANAGE. 35(2):193-204.

SEAS BEH PRED FEED BEH DETER/REPEL
CONTROL

AKKA,AK , ,KARL,KOIS

00347

GARNER, G.W., H.V. REYNOLDS, L.D. MARTIN, T.J. WILMERS AND T.J. DOYLE.
1984
ECOLOGY OF BROWN BEARS INHABITING THE COASTAL PLAIN AND ADJACENT FOOTHILLS AND MOUNTAINS OF THE NORTHEASTERN PORTION OF THE ARCTIC NATIONAL WILDLIFE REFUGE.

PP.330-358 IN: ARCTIC NATL. WILDL. REFUGE PROG. REP. FY84-11.

AGE/SEX MEAS/QUANT DEN
POP DENS POP EST REP RATE PRED

ARC ,AK ,ANWR, ,

00348

GARSHELIS, D.L., H.B. QUIGLEY, C.R. VILLARRUBIA AND M.R. PELTON.

1982
ASSESSMENT OF TELEMETRIC MOTION SENSORS FOR STUDIES OF ACTIVITY.

CAN. J. ZOOL. 60(8):1800-1805.

TELEM

,GEN , , ,

00349

GASAWAY, W.C., R.D. BOERTJE, D.V. GRANGAARD, D.G. KELLEYHOUSE AND R.O. STEPHENSON.
1986
FACTORS LIMITING MOOSE POPULATION GROWTH IN GAME MANAGEMENT UNIT 20E.

FED. AID WILDL. REST. PROJ. W-22-4 AND W-22-5, JOB 1.37R. PROG. REP. ALASKA DEP. FISH AND GAME, JUNEAU. 52 PP.

PRED

AK-I,AK , , ,

00350

GATESMAN, T. AND H. WIESNER.

1982
IMMOBILIZATION OF POLAR (THALARCTOS MARITIMUS) AND BROWN (URSUS ARCTOS) BEARS USING ETORPHINE AND XYLAZINE.

J. ZOO ANIM. MED. 13:11-18.

DRUGS

,GEN , , ,

00351

GEBHARD, J.G.

1982
ANNUAL ACTIVITIES AND BEHAVIOR OF A GRIZZLY BEAR (URSUS ARCTOS) FAMILY IN NORTHERN ALASKA.

M.S. THESIS, UNIV. ALASKA, FAIRBANKS. 218 PP.

BEHAV PATT	ACT PATT	FEED BEH	MATERNAL
PRED	AIRCRAFT IMP	VOCAL	SIB BEH
AGON			

ARC ,AK , , ,WBRK

00352

GEIST, O.W.

1934
BROWN BEAR SEEN ON ST. LAWRENCE ISLAND.

J. MAMMAL. 15(4):316-317.

HIST DISTR HIST ACCT

,AK , , ,

00353

GEIST, V.

1978
BEHAVIOR.

CHAPTER 19. PP. 283-296 IN: J.L. SCHMIDT AND D.L. GILBERT, EDS. B
IG GAME OF NORTH AMERICA: ECOLOGY AND MANAGEMENT. STACKPOLE BOOKS
, HARRISBURG, PENN.

HUMAN IMP MORPH/PHYS

,GEN , , ,

00354

GILBERT, J.R., W.S. KORDEK, J. COLLINS AND R. CONLEY.

1978
INTERPRETING SEX AND AGE DATA FROM LEGAL KILLS OF BEARS.

PROC. EAST. WORKSHOP BLACK BEAR MANAGE. AND RES. 4:253-262.

HARV MGMT AGE/SEX

,GEN , , ,

00355

GILBERT, B.K. AND L.D. ROY.

1977
PREVENTION OF BLACK BEAR DAMAGE TO BEEYARDS USING AVERSIVE CONDIT
IONING.

PP. 93-102 IN: R.L. PHILLIPS AND C. JONKEL, EDS. PROC. OF THE 197
5 PREDATOR SYMPOSIUM MONT. FOR. AND CONSERV. EXP. STAT., UNIV. MO
NT., MISSOULA.

AVER COND

,GEN , , ,

00356

GILLESPIE, D. AND C. JONKEL.

1979
GRIZZLY BEAR DENS IN THE BORDER GRIZZLY AREA.

PP. 105-121 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ
., UNIV. MONT., MISSOULA. ANNU. REP. NO. 4.

DEN CHAR MGMT GEN DEN CHRON DEN SITE

NCDE,MT , , ,

00357

GILLESPIE, D. AND C. JONKEL.

1980
GRIZZLY BEAR DENNING IN THE SOUTH FORK OF THE FLATHEAD RIVER.

PP. 178-195 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ
., UNIV. MONT., MISSOULA. ANNU. REP. NO. 5.

DEN MAP/TYPE

NCDE,MT , , ,SFLT

00358

GILLHAM, C.E.

1948
WILDLIFE INVESTIGATIONS OF ALASKA.

FED. AID WILDL. REST. PROJ. W-3-R-3, WORK PLAN 3. QUART. REP. VOL
. 3, NO. 1. ALASKA DEP. FISH AND GAME, JUNEAU. 3 PP.

FOOD PRED

AKPN,AK , , ,KENA

00359

GLENN, L.P.

1971
REPORT ON 1970 BROWN BEAR STUDIES.

FED. AID WILDL. REST. PROJ. W-17-2, JOBS 4.1R, 4.2R AND 4.3R (2ND
HALF) AND PROJ. W-17-3, JOBS 4.2R AND 4.4R. PROG. REP., VOL. 12.
ALASKA DEP. FISH AND GAME, JUNEAU. 67 PP.

CAPTURE LITR SIZE PRED CANNIBAL
MATERNAL RECR IMP ACT PATT AGE/SEX
MEAS/QUANT
AKPN,AK , , ,BLKL

00360

GLENN, L.P.

1972
REPORT ON 1971 BROWN BEAR STUDIES.

FED. AID WILDL. REST. PROJ. W-17-R-3 AND W-17-R-4. PROG. REP. ALA
SKA DEP. FISH AND GAME, JUNEAU. 109 PP.

AGE/SEX MEAS/QUANT MOVE BRD AGE
PRED DRUGS CAPTURE

AKPN,AK , , ,BLKL

00361

GLENN, L.P.

1973A
REPORT ON 1972 BROWN BEAR STUDIES: BROWN BEAR LIFE HISTORY.

FED. AID WILDL. REST. PROJ. W-17-4 AND W-17-5, JOB 4.2R, PROG. RE
P., JAN. 1, 1972-DEC. 31-1972. ALASKA DEP. FISH AND GAME, JUNEAU.
16 PP.

LITR SIZE   MORT DATA   LITR FREQ   AGE/SEX
GROW/DEV   WEIGHT

AKPN,AK , , ,BLKL

00362

GLENN, L.P.

1973B
REPORT ON 1972 BROWN BEAR STUDIES: DISTRIBUTION AND MOVEMENTS OF
ALASKA PENINSULA BROWN BEARS.

FED. AID WILDL. REST. PROJ. W-17-4 AND W-17-5, JOB 4.4R, PROG. RE
P., JAN. 1, 1972-DEC. 31-1972. ALASKA DEP. FISH AND GAME, JUNEAU.
23 PP.

MOVE   HARV DATA   POP EST

AKPN,AK , , ,BLKL

00363

GLENN, L.P.

1974
REPORT ON 1973 BROWN BEAR STUDIES: DISTRIBUTION AND MOVEMENTS OF
ALASKA PENINSULA BROWN BEARS.

FED. AID WILDL. REST. PROJ. W-17-5 AND W-17-6, JOB 4.4R. PROGR. R
EP., JAN. 1, 1973-DEC. 31, 1973. ALASKA DEP. FISH AND GAME, JUNEA
U. 10 PP.

HARV DATA

AKPN,AK , , ,BLKL

00364

GLENN, L.P.

1975
REPORT ON 1974 BROWN BEAR STUDIES: DISTRIBUTION AND MOVEMENT OF A
LASKA PENINSULA BROWN BEARS.

FED. AID WILDL. REST. PROJ. W-17-6 AND W-17-7, JOB 4.4R. PROG. RE
P., JAN. 1, 1974-DEC. 31, 1974. ALASKA DEP. FISH AND GAME, JUNEAU
. 54 PP.

MOVE   FOOD   PRED   AGE/SEX
HARV DATA   SKULL   MISC QUANT

AKPN,AK , , ,BLKL

00365

GLENN, L.P.

1976
REPORT ON 1975 BROWN BEAR STUDIES: DISTRIBUTION AND MOVEMENTS OF ALASKA PENINSULA BROWN BEARS.

FED. AID WILDL. REST. PROJ. W-17-7 AND W-17-8, JOB 4.4R. PROG. R EP., VOL XVI, JAN. 1, 1975-DEC. 31, 1975. ALASKA DEP. FISH AND GA ME, JUNEAU. 18 PP.

MOVE

AKPN,AK , , ,BLKL

00366

GLENN, L.P.

1980
MORPHOMETRIC CHARACTERISTICS OF BROWN BEARS ON THE CENTRAL ALASKA PENINSULA.

INT. CONF. BEAR RES. AND MANAGE. 4:313-319.

GROW/DEV	SKULL	GIRTH	WEIGHT
LENGTH	MISC QUANT	AGE DETERM	DENT

AKPN,AK , , ,

00367

GLENN, L.P., J.W. LENTFER, J.B. FARO AND L.H. MILLER.

1976
REPRODUCTIVE BIOLOGY OF FEMALE BROWN BEARS (URSUS ARCTOS), MCNEIL RIVER, ALASKA.

INT. CONF. BEAR RES. AND MANAGE. 3:381-390.

BRD AGE	LITR FREQ	WEAN	COURT
LITR SIZE	MORT RATE	SIB BEH	MATERNAL

AKPN,AK ,MCGS, ,MCNE

00368

GLENN, L.P. AND L.H. MILLER.

1970
REPORT ON 1969 BROWN BEAR STUDIES. EVALUATION AND DEVELOPMENT OF BROWN BEAR CENSUS TECHNIQUES. BROWN BEAR LIFE HISTORY STUDY. COMP ARISON OF HARVEST DATA AND POPULATION STATUS.

FED. AID WILDL. REST. PROJ. W-17-2, WORK PLAN R, JOB NOS.4.1R, 4.2R, AND 4.3R. ANNU. SEG. REP., JAN. 1, 1969-DEC. 31, 1969. ALASKA DEP. FISH AND GAME, JUNEAU. 63 PP.

PRED	MATERNAL	CENSUS/TREND	HARV DATA
POP BIOL	GROW/DEV	MEAS/QUANT	CENSUS METH
AGE DETERM			

,AK , , ,

00369

GLENN, L.P. AND L.H. MILLER.

1980
SEASONAL MOVEMENTS OF AN ALASKA PENINSULA BROWN BEAR POPULATION.

INT. CONF. BEAR RES. AND MANAGE. 4:307-312.

MOVE PRED HOME RNG MATERNAL

AKPN,AK , , ,

C0370

GOODWIN, E. AND S. MILLER.

1982
PRELIMINARY RESULTS TESTING TECHNIQUE TO CHEMICALLY DIFFERENTIATE BETWEEN SCATS OF BLACK AND BROWN BEAR.

APPENDIX 6. PP. 230-233 IN: S.D. MILLER AND D.C. MCALLISTER. BIG GAME STUDIES, VOL. VI. BLACK BEAR AND BROWN BEAR. SUSITNA HYDROELECTRIC PROJECT PHASE 1 FINAL REPORT. ALASKA DEP. FISH AND GAME, JUNEAU.

SCAT ANAL IDENT/RECOG

,GEN , , ,

00371

GORDON, K.R.

1977
MOLAR MEASUREMENTS AS A TAXONOMIC TOOL IN URSUS.

J. MAMMAL. 58(2):247-248.

DENT IDENT/RECOG SKULL

,GEN , , ,

00372

GRAHAM, D.C.

1978
GRIZZLY BEAR DISTRIBUTION USE OF HABITATS, FOOD HABITS AND HABITAT CHARACTERIZATION IN PELICAN AND HAYDEN VALLEYS, YELLOWSTONE NATIONAL PARK.

M.S. THESIS, MONT. STATE UNIV., BOZEMAN. 89 PP.

NUTR ANAL FOOD AIRCRAFT IMP TIMB USE
HAB USE SEAS BEH PRED UNG COMP
FOR STRAT

YGBE,WY ,YNP , ,HAYD

00373

GREENE, ROBERT J.

1982
AN APPLICATION OF BEHAVIORAL TECHNOLOGY TO THE PROBLEM OF NUISANC
E BEARS.

PSYCHOL. REC. 32:501-511.

DETER/REPEL

,GEN , , ,

00374

GREER, K.R.

1959
WILDLIFE INVESTIGATIONS LABORATORY.

FED. AID WILDL. REST. PROJ. W-83-R-2. JOB COMPLETION REP., MAY 1,
1958-APR. 30, 1959. MONT. FISH AND GAME DEP., HELENA. 13 PP.

FOOD

NCDE,MT ,USFS, ,MISS

00375

GREER, K.R.

1968
GRIZZLY BEAR HARVEST IN MONTANA DURING 1967.

APPENDIX 2. PP. 11-20 IN: WILDLIFE INVESTIGATICNS LABORATCRY-LABO
RATORY SERVICES. FED. AID WILDL. REST. PROJ. W-83-R-11, JOB A-1.
JOB COMPLETION REP., JULY 1, 1967-JUNE 30, 1968. MONT. FISH AND G
AME DEP., HELENA.

HARV MGMT HARV DATA MISC QUANT AGE DETERM
MORT DATA CONTROL

,MT , , ,

00376

GREER, K.R.

1969
GRIZZLY BEAR HARVEST IN MONTANA DURING 1968.

APPENDIX 2. PP. 20-29 IN: WILDLIFE INVESTIGATICNS LABORATORY - LA
BORATORY SERVICES. FED. AID WILDL. REST. PROJ. W-83-R-12. JOB COM
PLETION REP., JULY 1, 1968-JUNE 30, 1969. MONT. FISH AND GAME DEP
., HELENA.

HARV DATA MORT DATA CONTROL MISC QUANT
SKULL WEIGHT LENGTH PARAS/DIS
LEGAL

,MT , , ,

00377

GREER, K.R.

1970
GRIZZLY BEAR AND BLACK BEAR HARVEST IN MONTANA DURING 1969.

APPENDIX 3. PP. 15-28 IN: STATEWIDE WILDLIFE RESEARCH - LABORATOR
Y SERVICES. FED. AID WILDL. REST. PROJ. W-120-R-1, JOB 3.1. JULY
1969-JUNE 1970. MONT. FISH AND GAME DEP., HELENA.

HARV DATA CONTROL DEPRED POACH/ILLEG
WEIGHT LENGTH PARAS/DIS

,MT , , ,

00378

GREER, K.R.

1971
GRIZZLY BEAR HARVEST IN MONTANA DURING 1970.

APPENDIX III. PP. 15-28 IN: STATEWIDE WILDLIFE RESEARCH - LABORAT
ORY SERVICES. FED. AID WILDL. REST. PROJ. W-120-R-2, JOB L-10. JO
B COMPLETION REP., JULY 1969-JUNE 1970. MONT. FISH AND GAME DEP.,
HELENA.

HARV DATA CONTROL DEPRED HARV DATA
AGE/SEX MEAS/QUANT MORPH/PHYS PARAS/DIS
GARBAGE

,MT , , ,

00379

GREER, K.R.

1972A
GRIZZLY BEAR MORTALITY AND STUDIES IN MONTANA.

INT. CONF. BEAR RES. AND MANAGE. 2:53-66.

HARV DATA IDENT/RECOG MORT DATA POACH/ILLEG
PARAS/DIS AGE/SEX MEAS/QUANT

,MT , , ,

00380

GREER, K.R.

1972B
GRIZZLY BEAR MORTALITY AND MANAGEMENT PROGRAMS IN MONTANA DURING
1971.

FED. AID WILDL. REST. PROJ. W-120-R-3, JOB L-1.1. WORK PLAN IV. J
OB PROG. REP., MAY 1, 1971-DEC. 31, 1971. MONT. FISH AND GAME DEP
., HELENA. 44 PP.

RELOC MORT DATA MEAS/QUANT RES TECH
DENT SKULL AGE/SEX PARAS/DIS
GARBAGE

,MT , , ,

00381

GREER, K.R.

1974
GRIZZLY BEAR MORTALITY AND MANAGEMENT PROGRAMS IN MONTANA DURING 1972.

FED. AID WILDL. REST. PROJ. W-120-R-4, JOB L-1.1, WORK PLAN IV. PROG. REP., MAY 1, 1972-DEC. 31, 1972. MONT. DEP. FISH AND GAME, HELENA. 30 PP.

HARV DATA	AGE/SEX	MORT DATA	POACH/ILLEG
MEAS/QUANT	PARAS/DIS	GARBAGE	CONTROL
RELOC			

,MT , , ,

00382

GREER, K.R.

1975
GRIZZLY BEAR MORTALITY AND MANAGEMENT PROGRAMS IN MONTANA DURING 1974.

FED. AID WILDL. REST. PROJ. W-120-R-6, JOB L-1.1, WORK PLAN IV. PROG. REP., MAY 1, 1974-DEC. 31, 1974. MONT. DEP. FISH AND GAME, HELENA. 23 PP.

HARV DATA	AGE/SEX	GARBAGE	MORT DATA
PRES DISTR	LIVESTK IMP	MORT MGMT	WEAN

,MT , , ,

00383

GREER, K.R.

1976A
GRIZZLY BEAR MORTALITY AND MANAGEMENT PROGRAMS IN MONTANA DURING 1975.

FED. AID WILDL. REST. PROJ. W-120-R-7, JOB L-1.1, WORK PLAN IV. PROG. REP., MAY 1, 1975-DEC. 31, 1975. MONT. FISH AND GAME DEP., HELENA. 20 PP.

HARV DATA	WEAN	MORT DATA	POACH/ILLEG
CONTROL	AGE/SEX	PARAS/DIS	WEIGHT
DEN CHRON			

,MT , , ,

00384

GREER, K.R.

1976B
MANAGING MONTANA'S GRIZZLIES FOR THE GRIZZLIES.

INT. CONF. BEAR RES. AND MANAGE. 3:177-189.

MORT DATA	POACH/ILLEG	CONTROL	HARV DATA
AGE/SEX	GARBAGE	DEPRED	

,MT , , ,

00385

GREER, K.R.

1977
GRIZZLY BEAR MORTALITY AND MANAGEMENT PROGRAMS IN MONTANA DURING 1976.

FED. AID WILDL. REST. PROJ. W-120-R-8, JOB L-1.1, WORK PLAN IV. PROG. REP., MAY 1, 1976-DEC. 31, 1976. MONT. FISH AND GAME DEP., HELENA. 20 PP.

MORT DATA	CONTROL	POACH/ILLEG	PARAS/DIS
AGE/SEX	HARV DATA	HARV MGMT	WEIGHT
GARBAGE			

,MT , , ,

00386

GREER, K.R.

1978
GRIZZLY BEAR MORTALITY AND MANAGEMENT PROGRAMS IN MONTANA DURING 1977.

FED. AID WILDL. REST. PROJ. W-120-R-9, JOB L-1.1, WORK PLAN IV. PROG. REP., MAY 1, 1977-DEC. 31, 1977. MONT. FISH AND GAME DEP., HELENA. 18 PP.

HARV DATA	MORT DATA	RELOC	AGE/SEX
SKULL	CONTROL	PARAS/DIS	GEN DATA
HARV MGMT			

,MT , , ,

00387

GREER, K.R.

1979
GRIZZLY BEAR STUDIES.

FED. AID WILDL. REST. PROJ. W-120-R-10, JOB 2, WORK PLAN V, STUDY NO. L-1.1. PROG. REP., MAY 1, 1978-DEC. 31, 1978. MONT. FISH AND GAME DEPT., HELENA. 13 PP.

HARV DATA	MORT DATA	POACH/ILLEG	DEPRED
CONTROL	RELOC	AGE/SEX	GARBAGE
HARV MGMT			

,MT , , ,

00388

GREER, K.R.

1980
GRIZZLY BEAR STUDIES DURING 1979.

FED. AID WILDL. REST. PROJ. W-120-R-11, JOB 2, WORK PLAN V, STUDY NO. L-1.1. PROG. REP., MAY 1, 1979-DEC. 31, 1979. MONT. FISH AND GAME DEP., HELENA. 22 PP.

HARV DATA	POACH/ILLEG	CONTROL	RES MORT
RELOC	DEPRED	PARAS/DIS	MORT DATA
DEMOG ANAL			

,IMW , , ,

00389

GREER, K.R.

1981
GRIZZLY BEAR MORTALITY STUDIES (1980).

FED. AID WILDL. REST. PROJ. W-120-R-12, JOB NO. 2, STUDY NO. WL-1.0, PROGRAM NO. V. PROG. REP., MAY 1, 1980-DEC. 31, 1980. MONT. FISH AND GAME DEP., HELENA. 22 PP.

MORT DATA	POACH/ILLEG	HARV DATA	CONTROL
AGE/SEX	DEPRED	POP EST	MGMT GEN

,MT , , ,

00390

GREER, K.R.

1982
GRIZZLY BEAR MORTALITY STUDIES (1981).

FED. AID WILDL. REST. PROJ. W-120-R-13, JOB NO. 2, STUDY NO. WL-1.0, PROGRAM NO. V. PROG. REP., MAY 1, 1981-DEC. 31, 1981. MONT. DEP. FISH, WILDL. AND PARKS, HELENA. 20 PP.

MORT DATA	RECR IMP	HARV DATA	RELOC
DEPRED	PARAS/DIS	POACH/ILLEG	

,MT , , ,

00391

GREER, K.R.

1983
GRIZZLY BEAR MORTALITY STUDIES (1982).

FED. AID WILDL. REST. PROJ. W-120-R-14, JOB 2, STUDY WL-1.0, PROGRAM V. PROG. REP., MAY 1, 1982-DEC. 31, 1982. MONT. DEP. FISH, WILDL. AND PARKS, HELENA. 29 PP.

MORT DATA	HARV DATA	POACH/ILLEG	RES MORT
ROAD MORT	CONTROL	AGE/SEX	RELOC
PARAS/DIS			

,MT , , ,

00392

GREER, K.R.

1985
MONTANA STATEWIDE GRIZZLY BEAR MORTALITIES 1983-1984.

MONT. DEP. OF FISH, WILDL., AND PARKS. 51 PP.

MORT DATA	HARV DATA	AGE/SEX	SKULL
DEPRED	CONTROL	POACH/ILLEG	

,MT , , ,

00393

GREER, K.R. AND V. CRAIG.

1971
BEAR HUNTING IN MONTANA.

MONT. FISH AND GAME DEP., HELENA. 7 PP.

IDENT/RECOG   PELAGE   MISC QUANT   DENT

,MT , , ,

00394

GREER, K.R. AND C.J. JONKEL.

1975
ENVIRONMENTAL IMPACT STATEMENT ON THE SPORT HUNTING OF THE GRIZZL
Y BEAR: ADDENDUM TO 1972 EIS ON STATEWIDE BIG GAME HUNTING SEASON
S.

MONT. FISH AND GAME DEP., HELENA. 10 PP.

HARV MGMT   MGMT GEN

,MT , , ,

00395

GRIFFEL, D.

1976
BEAR-LIVESTOCK INTERACTIONS OF THE TARGHEE NATIONAL FOREST.

U.S.D.A. FOREST SERV., TARGHEE NATL. FOREST, IDAHO. 15 PP.

DEPRED   CONTROL

YGBE,ID ,TANF, ,ASHT

00396

GRIFFEL, D.

1977
BEAR-LIVESTOCK INTERACTION STUDY - 1977.

U.S.D.A. FOREST SERV., TARGHEE NATL. FOREST, IDAHO. 27 PP.

DEPRED

YGBE,ID ,TANF, ,ASHT

00397

GRIFFEL, D.

1982
PREDATOR-LIVESTOCK RELATIONSHIPS IN SUMMER ON THE TARGHEE NATIONA
L FOREST, IDAHO.

PP. 295-305 IN: J.M. PEEK AND P.D. DALKE, EDS. PROC. WILDLIFE-LIV
ESTOCK RELATIONSHIPS SYMPOSIUM, VOL. 10.

DEPRED LIVESTK IMP LIVESTK MGMT

YGBE,ID ,TANF, ,

00398

GRIFFEL, D.E. AND J.V. BASILE.

1981
IDENTIFYING SHEEP KILLED BY BEARS.

U.S.D.A., FOREST SERV., INTERMOUNTAIN FOREST AND RANGE EXPT. STAT
. RES. NOTE INT-313. 3 PP.

DEPRED FEED BEH CARCASS

YGBE,ID ,TANF, ,

00399

GRITMAN, J.C.

1979
FORMAL SELECTION 7 CONSULTATION ON GRANT VILLAGE, YELLOWSTONE PAR
K.

U.S.D.I., FISH AND WILDL. SERV. 28 PP.

RECR IMP

YGBE,IMW ,YNP , ,

00400

GUILIDAY, J. E.

1968
GRIZZLY BEARS FROM EASTERN NORTH AMERICA.

AM. MIDL. NAT. 79(1):247-250.

HIST DISTR

,GEN , , ,

00401

GUNN, A. AND F.L. MILLER.

1982
MUSKOX BULL KILLED BY A BARREN-GROUND GRIZZLY BEAR, THELON GAME S
ANCTUARY, N.W.T.

ARCTIC 35(4):545-546.

PRED FEED BEH

,NWT ,THGS, ,

00402

GUNSON, J.R.

1981
COMMENTS ON STATUS AND MANAGEMENT OF GRIZZLY BEARS IN ALBERTA.

ALBERTA FISH AND WILDL. DIV., EDMONTON. 4 PP.

PRES DISTR POP EST HARV MGMT DEPRED
POACH/ILLEG AGE/SEX HUMAN INJ CONTROL

,AT , , ,

00403

GUNSON, J.R., R.B. SCHAUFELE AND B.H. TREICHEL.

1985
MORTALITIES OF GRIZZLY BEARS IN ALBERTA: 1972-84.

ALBERTA FISH AND WILDL. DIV., EDMONTON. 48 PP.

HARV DATA MORT DATA POACH/ILLEG AGE/SEX
CONTROL RES MORT HUMAN INJ REACTION
RECR IMP
,AT , , ,

00404

GUNTHER, K.

1984A
THE EFFECTS OF BACKCOUNTRY RECREATIONAL USE ON BEAR USE IN THE PE
LICAN VALLEY AREA OF YELLOWSTONE NATIONAL PARK.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. 20 PP.

NONMOTOR IMP ACT PATT INTRASP BEH REACTION
CLOSURE

YGBE,WY ,YNP , ,PELI

00405

GUNTHER, K.

1984B
RELATIONSHIP BETWEEN ANGLER AND BEAR USE IN THE CLEAR CREEK AREA OF YELLOWSTONE LAKE.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. INFO. PAP. NO. 40. 8 PP.

CLOSURE PRED NONMOTOR IMP

YGBE,WY ,YNP , ,CLCR

00406

GUNTHER, K. AND R. RENKIN.

1985
THE EFFECTS OF BACKCOUNTRY RECREATIONAL ACTIVITY ON BEAR USE IN THE PELICAN VALLEY AREA OF YELLOWSTONE NATIONAL PARK.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. PRELIMINARY PROG. REP. 36 PP.

NONMOTOR IMP TIMB USE COVER HAB USE
REACTION CLOSURE ACT PATT PRED
NONMOTOR IMP
YGBE,WY ,YNP , ,PELI

00407

GUSTAVSON, C.R., D.J. KELLY AND J. GARCIA.

1975
PREDATION AND AVERSIVE CONDITIONING IN COYOTES.

SCIENCE 187:1096.

AVER COND

,GEN , , ,

00408

GUSTAVSON, C.R., D.J. KELLY AND M. SWEENEY.

1976
PREY-LITHIUM AVERSIONS I: COYOTES AND WOLVES.

BEHAV. BIOL. 17:61-72.

AVER COND

,GEN , , ,

00409

HADDEN, D.A., W.J. HANN AND C.J. JONKEL.

1986
AN ECOLOGICAL TAXONOMY FOR EVALUATING GRIZZLY BEAR HABITAT IN THE
WHITEFISH RANGE OF MONTANA.

PP. 67-77 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRI
ZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERVICE. INTERMOUNT
AIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

MAP/TYPE TYPE DESCRIP HAB SAMPL HAB EFFECT

NCDE,MT ,KONF,FLNF,WHR

C0410

HADDEN, D. AND C. JONKEL.

1983
AN INVENTORY AND EVALUATION OF WILDLIFE AND WILDLIFE HABITAT ON T
HE BIG MOUNTAIN, MONTANA.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 64. 1
29 PP.

RECR IMP MAP/TYPE HAB RECON HUMAN IMP
CUM EFF TIMB MGMT SUBDIV MGMT ROAD MGMT
MOVE
NCDE,MT ,FLNF, ,WHR

00411

HAGLUND, B.

1974
MOOSE RELATIONS WITH PREDATORS IN SWEDEN, WITH SPECIAL REFERENCE
TO BEAR AND WOLVERINE.

NATURALISTE CAN. 101:457-466.

PRED

,GEN , , ,

00412

HAIGH, J.C. AND G.B. STENHOUSE.

1985
FATAL TRAUMA CAUSED BY A DETERRENT DEVICE FOR BEARS.

J. WILDL. DIS. 21(3):330-331.

DETER/REPEL CONTROL

,GEN , , ,

00413

HAIGH, J.C., I. STIRLING AND E. BROUGHTON.

1984
CLINICAL EXPERIENCES WITH TELAZOL (R) FOR POLAR BEAR (URSUS MARIT
IMUS PHIPPS) IMMOBILIZATION.

ANNU. PROC. AM. ASSOC. ZOO VET. 1984:130-131.

DRUGS

,GEN , , ,

00414

HAIGH, J.C., I. STIRLING AND E. BROUGHTON.

1985
IMMOBILIZATION OF POLAR BEARS (URSUS MARITIMUS PHIPPS) WITH A MIX
TURE OF TILETAMINE HYDROCHLORIDE.

J. WILDL. DIS. 21(1)::43-47.

DRUGS

,GEN , , ,

00415

HALL, E.R.

1928
RECORDS OF SUPERNUMERARY TEETH IN BEARS.

UNIV. CALIF. PUBL. ZOOL. 30(11):243-250.

DENT

,GEN , , ,

00416

HALL, E.R.

1945
DENTAL CARIES IN WILD BEARS.

TRANS. KANS. ACAD. SCI. 48(1):79-85.

DENT PARAS/DIS

,GEN , , ,

00417

HALL, E.R.

1981
THE MAMMALS OF NORTH AMERICA. VOL. II.

JOHN WILEY AND SONS, NY. 181 PP.

TAXON/EVOL HIST DISTR

,GEN , , ,

00418

HALL, E.R.

1984
GEOGRAPHIC VARIATION AMONG BROWN AND GRIZZLY BEARS (URSUS ARCTOS) IN NORTH AMERICA.

MUS. NAT. HIST., UNIV. KANSAS, LAWRENCE. SPEC. PUBL. 13. 16 PP.

TAXON/EVOL DENT SKULL DISTR

,GEN , , ,

00419

HALLORAN, D.W. AND A.M. PEARSON.

1972
BLOOD CHEMISTRY OF THE BROWN BEAR (URSUS ARCTOS) FROM SOUTHWESTER
N YUKON TERRITORY, CANADA.

CAN. J. ZOOL. 50(6):827-833.

HEMAT HIB PHYS

,GEN , , ,

00420

HALVORSON, G.L.

1973
SOME GRIZZLY BEAR OBSERVATIONS.

U.S.D.A., FOREST SERV., LOLO NATL. FOREST, MONT. 5 PP.

HAB USE SEAS BEH FOOD

CYE ,MT ,LONF, ,

00421

HAMER, D.

1974
THE GRIZZLY BEAR IN MOUNT REVELSTOKE PARK.

PARKS CANADA, REVELSTOKE NATL. PARK, B.C. 6 PP.

HAB RECON HAB USE MOVE NONMOT MGMT

BC-I,BC ,REVL, ,

00422

HAMER, J.D.W.

1974
DISTRIBUTION, ABUNDANCE, AND MANAGEMENT IMPLICATIONS OF THE GRIZZ LY BEAR AND MOUNTAIN CARIBOU IN THE MOUNTAIN CREEK WATERSHED OF G LACIER NATIONAL PARK, BRITISH COLUMBIA.

M.S. THESIS, UNIV. CALGARY, ALBERTA. 164 PP.

HAB USE MOVE FOOD MGMT GEN
RECR MGMT

BC-I,BC ,CGNP, ,

00423

HAMER, J.D.W.

1985
FEEDING ECOLOGY OF GRIZZLY BEARS IN THE CASCADE AND PANTHER VALLE Y OF BANFF NATIONAL PARK.

PH.D. DISS., UNIV. CALGARY, ALBERTA. 247 PP.

HAB USE MOVE FOOD FIRE MGMT
COVER PRED CARCASS DIGEST
NUTR ANAL
CR ,AT ,BANP, ,CASC

00424

HAMER, D. AND S. HERRERO.

1983A
MOVEMENTS, FOOD, AND HABITAT OF GRIZZLY BEARS IN THE CASCADE AND PANTHER VALLEYS OF BANFF NATIONAL PARK.

PP. 9-263 IN: D. HAMER AND S. HERRERO, ED. ECOLOGICAL STUDIES OF THE GRIZZLY BEAR, BANFF NATIONAL PARK. PREP. FOR PARKS CANADA CON TRACT WR 4-80. UNIV. CALGARY, ALBERTA. FINAL REP.

HAB USE MGMT GEN GEN DATA PRED
COURT DEN NUTR ANAL CARCASS
REACTION
CR ,AT ,BANP, ,CASC

00425

HAMER, D. AND S. HERRERO (EDS).

1983B
ECOLOGICAL STUDIES OF THE GRIZZLY BEAR IN BANFF NATIONAL PARK.

FINAL REP. PREP FOR PARKS CANADA. CONTRACT WR 4-80. PREP. BY UNIV
. OF CALGARY, ALBERTA. 303 PP.

MAP/TYPE	HAB USE	MGMT GEN	PRED
CARCASS	REACTION	GEN DATA	DEN
COURT			

CR ,AT ,BANP, ,CASC

00426

HAMER, D. AND S. HERRERO.

IN PRESSA
FOOD AND HABITAT USED BY GRIZZLY BEARS IN THE FRONT RANGES OF BAN
FF NATIONAL PARK, ALBERTA.

INT. CONF. BEAR RES. AND MANAGE. 7.

HAB USE	FOOD	NUTR ANAL	VEG SUCC
BURN USE/MGT	FOR STRAT		

CR ,AT ,BANP, ,CASC

00427

HAMER, D. AND S. HERRERO.

IN PRESSB
WILDFIRE'S INFLUENCE ON GRIZZLY BEAR FEEDING ECOLOGY IN THE FRONT
RANGES OF BANFF NATIONAL PARK, ALBERTA.

INT. CONF. BEAR RES. AND MANAGE. 7.

HAB USE	BURN USE/MGT	FOOD	VEG SUCC
FIRE MGMT			

CR ,AT ,BANP, ,

00428

HAMER, D., S. HERRERO AND K. BRADY.

1982
THE GRIZZLY BEAR IN WATERTON LAKES NATIONAL PARK.

YEAR 1. PROGR. REP. 1981. PREP. FOR PARKS CANADA. CONTRACT WR 66-
81. PREP. BY UNIV. CALGARY, ALBERTA. 51 PP.

HOME RNG	MOVE	FOOD	CARCASS
PRED	REACTION		

CR ,AT ,WANP, ,

00429

HAMER, D., S. HERRERO AND K. BRADY.

1983
THE GRIZZLY BEAR IN WATERTON LAKES NATIONAL PARK.

YEAR 2. PROG. REP 1982. PREP. FOR PARKS CANADA. CONTRACT WR 70-82
. PREP. BY UNIV. CALGARY, ALBERTA. 59 PP.

FOOD REACTION GARBAGE HUMAN INJ
NONMOT MGMT

CR ,AT ,WANP, ,

00430

HAMER, D., S. HERRERO AND K. BRADY.

1985
STUDIES OF THE GRIZZLY BEAR IN WATERTON LAKES NATIONAL PARK.

FINAL REP. PREP. FOR PARKS CANADA. CONTRACT WR 149-83. PREP. BY U
NIV. CALGARY, ALBERTA. 163 PP.

FOOD HAB USE DEN PRED
CARCASS FEED BEH REACTION

CR ,AT ,WANP, ,

00431

HAMER, D., S. HERRERO AND R.T. OGILVIE.

1977
ECOLOGICAL STUDIES OF THE BANFF NATIONAL PARK GRIZZLY BEAR, CUTHE
AD/WIGMORE REGION 1976.

PRELIMINARY REP. PREP. FOR PARKS CANADA. CONTRACT WR 34-76. PREP.
BY UNIV. CALGARY, ALBERTA. 234 PP.

FOOD PRED CARCASS FEED BEH
NUTR ANAL HAB USE DEN COPULATE
COURT

CR ,AT ,BANP, ,CUWI

00432

HAMER, D., S. HERRERO AND R.T. OGILVIE.

1978
ECOLOGICAL STUDIES OF THE BANFF NATIONAL PARK GRIZZLY BEAR, CUTHE
AD/WIGMORE REGION 1977.

YEAR 2. PRELIMINARY REP. PREP. FOR PARKS CANADA. CONTRACT WR 35-7
7. BY UNIV. CALGARY, ALBERTA. 50 PP.

FOOD MAP/TYPE HAB USE PRED
NUTR ANAL COURT WEAN SIB BEH

CR ,AT ,BANP, ,CUWI

00433

HAMER, D., S. HERRERO, R.T. OGILVIE AND T. TOTH.

1979
ECOLOGICAL STUDIES OF THE BANFF NATIONAL PARK GRIZZLY BEAR, CASCA
DE/PANTHER REGION 1978.

YEAR 3. PRELIMINARY REP. PREP. FOR PARKS CANADA. CONTRACT WR 96-7
8. PREP. BY UNIV. CALGARY, ALBERTA. 86 PP.

AIRCRAFT IMP   HOME RNG   DEN   FOOD
NUTR ANAL   HAB USE   MAP/TYPE   COURT

CR ,AT ,BANP, ,CASC

00434

HAMER, D., S. HERRERO, R.T. OGILVIE, T. TOTH AND A.H. MARSH.

1980
ECOLOGICAL STUDIES OF THE BANFF NATIONAL PARK GRIZZLY BEAR, CASCA
DE/PANTHER REGION 1979 (YEAR 4).

YEAR 4. PRELIMINARY REP. PREP. FOR PARKS CANADA. CONTRACT WR 48-7
9. PREP. BY UNIV. CALGARY, ALBERTA. 51 PP.

HOME RNG   DEN   FOOD   HAB USE
BURN USE/MGT   MAP/TYPE   COURT   WEAN
MARK

CR ,AT ,BANP, ,CASC

00435

HAMER, D., S. HERRERO AND L. ROGERS.

1981A
DIFFERENTIATING BLACK AND GRIZZLY BEAR FECES.

WILDL. SOC. BULL. 9(3):210-212.

SCAT ANAL   IDENT/RECOG

CR ,AT ,BANP, ,

00436

HAMER, D., S. HERRERO AND G.W. VROOM.

1981B
SELECTIVE CAPTURE OF GRIZZLY BEARS.

WILDL. SOC. BULL. 9(2):132-141.

CAPTURE

CR ,AT ,BANP, ,CASC

00437

HAMER, J.D.W.

1974
DISTRIBUTION, ABUNDANCE AND MANAGEMENT IMPLICATIONS OF THE GRIZZL
Y BEAR AND MOUNTAIN CARIBOU IN THE MOUNTAIN CREEK WATERSHED OF GL
ACIER NATIONAL PARK, BRITISH COLUMBIA.

M.S. THESIS. UNIV. CALGARY, ALBERTA. 164 PP.

HAB USE   MOVE   FOOD   MGMT GEN
RECR MGMT

BC-I,BC ,CGNP, ,

00438

HAMILTON, A.N.

1984
PROGRESS REPORT: COASTAL GRIZZLY RESEARCH PROJECT, YEAR 1 - 1982.

B.C. FISH AND WILDL. BRANCH, VICTORIA. 32 PP.

HARV DATA   RES MORT   MOVE   HOME RNG
HAB USE   FOOD   DAY BED   MARK
DEN
BC-C,BC , , ,KIMS

00439

HAMILTON, A.N. AND W.R. ARCHIBALD.

1984
COASTAL GRIZZLY RESEARCH PROJECT, PROGRESS REPORT, 1983, YEAR 2.

B.C. WILDL. BRANCH AND RESEARCH BRANCH, VICTORIA. WILDL. WORKING
PAP. NO. WR-2, WILDL. HABITAT RES. REP. NO. WHR-10. 27 PP.

          DAY BED   GEN DATA   MARK
AGE/SEX   DEN   BEHAV PATT

BC-C,BC , , ,KIMS

00440

HAMILTON, A.N. AND W.R. ARCHIBALD.

1986
GRIZZLY BEAR HABITAT IN THE KIMSQUIT RIVER VALLEY, COASTAL BRITIS
H COLUMBIA: EVALUATION.

PP. 50-57 IN G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZ
ZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN
RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

FOOD   HAB USE   TELEM

BC-C,BC , , ,KIMS

00441

HAMILTON, A.N. AND F.L. BUNNELL.

IN PRESS
FORAGING STRATEGIES OF COASTAL GRIZZLY BEARS IN THE KIMSQUIT RIVE
R VALLEY, BRITISH COLUMBIA.

INT. CONF. BEAR RES. AND MANAGE. 7.

HOME RNG HAB USE FOOD MOVE
FOR STRAT

BC-C,BC , , ,KIMS

00442

HAMILTON, T. AND B. SMITH.

1981
A FIELD GUIDE TO YUKON BEARS FOR THE EXPLORATION AND PLACER INDUS
TRIES.

YUKON WILDL. BRANCH, WHITEHORSE. 58 PP.

IDENT/RECOG GEN BIOL EDUC GEN DATA
GARB MGMT CAMP MGMT DETER/REPEL AVOID/ATTRAC
HUMAN INJ
,YK , , ,

00443

HAMLIN, K. L. AND M. FRISINA.

1975
SPECIAL GRIZZLY SURVEY.

FED. AID WILDL. REST. PROJ. NO. W-130-R-6, JOB I-1 AND I-4. PROG.
REP., JULY 1- DEC. 31, 1974. MONT. FISH AND GAME DEP., HELENA. 6
4 PP.

HAB RECON DISTR HAB USE CENSUS/TREND
FOOD

,MT , , ,

00444

HANSEN, J.M.

1981
VEGETATIONAL BEAR-FOOD AND COVER CHARACTERISTICS OF MISSION VALLE
Y RIPARIAN SEEP COMPLEXES AND OTHER LOW ELEVATION HABITAT TYPES.

B.S. THESIS (SENIOR), UNIV. MONTANA, MISSOULA.

COVER TYPE DESCRIP

NCDE,MT ,FLNF,FLIR,MISS

00445

HARDING, L.E.

1976
DEN-SITE CHARACTERISTICS OF ARCTIC COASTAL GRIZZLY BEARS (URSUS A
RCTOS L.) ON RICHARD'S ISLAND, NORTHWEST TERRITORIES, CANADA.

CAN. J. ZOOL. 54:1357-1363.

DEN SITE DEN CHAR DEN CHRON POP DENS
ENERGY IMP

CARC,NWT , , ,RICH

00446

HARDING, L. AND J.A. NAGY.

1980
RESPONSES OF GRIZZLY BEARS TO HYDROCARBON EXPLORATION ON RICHARDS
ISLAND, NORTHWEST TERRITORIES, CANADA.

INT. CONF. BEAR RES. AND MANAGE. 4:277-280.

ENERGY IMP AIRCRAFT IMP

CARC,NWT , , ,RICH

00447

HARESTAD, A.S.

1981
COMPUTER ANALYSIS OF HOME RANGE DATA.

B.C. FISH AND WILDL. BRANCH, VICTORIA. WILDL. RES. AND TECH. SERV
. SECT. FISH AND WILDL. BULL. NO. B-11. 26 PP.

HOME RNG

,GEN , , ,

00448

HARESTAD, A.S. AND F.L. BUNNELL.

1979
HOME RANGE AND BODY WEIGHT - A REEVALUATION.

ECOLOGY 60(2):389-402.

HOME RNG

,GEN , , ,

00449

HAROLDSON, M.

1980
PHENOLOGY OF GRIZZLY BEAR FOOD PLANTS: SEASONAL IMPORTANCE VALUES OF GRIZZLY HABITAT COMPONENTS.

B.S. THESIS (SENIOR)., UNIV. MONT., MISSOULA. 22 PP.

CUT USE HAB USE FOOD HAB EFFECT

NCDE,MT ,FLNF, ,SFLT

00450

HAROLDSON, M.

1984
TEST OF TEMPORARY BAITING OF GRIZZLY BEARS.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 15 PP.

AVOID/ATTRAC

YGBE,IMW ,YNP ,USFS,

00451

HAROLDSON, M. AND R. MACE.

IN PREP
GRIZZLY BEAR POPULATION AUGMENTATION.

DRAFT MANUSCRIPT PREP. FOR U.S. FISH AND WILDL. SERV. GRIZZLY BEA R RECOVERY COORDINATOR, MISSOULA, MONT. 15 PP.

POP AUG RELOC

,US , , ,

00452

HAROLDSON, M. AND D. MATTSON.

1985
RESPONSE OF GRIZZLY BEARS TO BACKCOUNTRY HUMAN USE IN YELLOWSTONE NATIONAL PARK.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 37 PP.

MOVE NONMOTOR IMP FEED BEH FOOD
FOR STRAT ACT PATT BEHAV PATT REACTION

YGBE,IMW ,YNP , ,

00453

HARPER, F.

1961
LAND AND FRESHWATER MAMMALS OF THE UNGAVA PENINSULA.

UNIV. KANSAS MUS. NAT. HIST, LAWRENCE. MISC. PUBL. NO. 27. 178 PP
.

HIST DISTR HIST ACCT

,CAN , , ,

00454

HARRIS, R.B.

1984A
PRELIMINARY EXPERIMENTS ON A SCENT-STATION INDEX FOR GRIZZLY BEAR
S.

FINAL REP. PREP. FOR U.S.D.I., FISH AND WILDL. SERV, OFFICE OF GR
IZZLY BEAR RECOVERY COORDINATOR. PREP. BY MONT. COOP. WILDL. RES.
UNIT, UNIV. MONT., MISSOULA. 30 PP.

CENSUS METH

NCDE,ATMT, , ,

00455

HARRIS, R.B.

1984B
HARVEST AGE-STRUCTURE AS AN INDICATOR OF GRIZZLY BEAR POPULATION
STATUS.

M.S. THESIS, UNIV. MONT., MISSOULA. 204 PP.

DEMOG ANAL HARV IMP AGE/SEX HARV MGMT

,GEN , , ,

00456

HARRIS, R.B.

1985A
MODELING SUSTAINABLE HARVEST RATES FOR GRIZZLY BEARS. (DRAFT).

MANUSCRIPT. 16 PP.

DEMOG ANAL HARV MGMT HARV IMP

NCDE,MT , , ,

00457

HARRIS, R.B.

1985B
DETECTING DECLINES IN SMALL GRIZZLY BEAR POPULATIONS: HOW WELL CA
N WE DO IT?

PP. 137-146 IN: R. LAMBERSON, ED. MATHEMATICAL MODELS OF RENEWABL
E RESOURCES, VOL. III. ASSOC. OF RESOURCE MODELERS, HUMBOLDT STAT
E UNIV., ARCATA, CALIF.

HARV IMP HARV MGMT DEMOG ANAL

,GEN , , ,

00458

HARRIS, R.B.

1986A
GRIZZLY BEAR POPULATION MONITORING: CURRENT OPTIONS AND CONSIDERA
TIONS.

MONTANA FOR. CONSERV. EXP. STAT., SCHOOL OF FORESTRY, UNIV. MONT.
, MISSOULA. MISC. PUBL. 45. 84 PP.

CENSUS METH HARV MGMT DEMOG ANAL

,GEN , , ,

00459

HARRIS, R.B.

1986B
RELIABILITY OF TREND LINES OBTAINED FROM VARIABLE COUNTS.

J. WILDL. MANAGE. 50(1):165-171.

CENSUS METH

,GEN , , ,

00460

HARRIS, R. (ED.).

1986C
RESULTS OF THE WORKSHOP ON GRIZZLY BEAR POPULATION GENETICS.

SPONSORED BY U.S.D.I., FISH AND WILDL. SERV., OFF. OF GRIZZLY BEA
R RECOVERY COORDINATOR, MISSOULA, MONT. 8 PP.

GENETICS POP AUG MIN POP

,GEN , , ,

00461

HARRIS, R.B. AND L.H. METZGAR.

1986A
STOCHASTIC INFLUENCES ON SUSTAINED YIELDS OF GRIZZLY BEAR POPULAT
IONS.

MONTANA COOP. WILDL. RES. UNIT, MISSOULA, MONT. DRAFT MANUSCRIPT
. 32 PP.

HARV MGMT DEMOG ANAL PCP REG

,GEN , , ,

00462

HARRIS, R.B. AND L.H. METZGAR.

1986B
REPRODUCTIVE VALUES OF GRIZZLY BEARS: A CONTRIBUTION TOWARDS THE
CUMULATIVE EFFECTS ANALYSIS.

FINAL REP. TO U.S. FOREST SERV., REGION 1, MISSOULA, MONT. 16 PP

DEMOG ANAL REPRO

,GEN , , ,

00463

HARRIS, R.B. AND L.H. METZGAR.

IN PRESSA
ESTIMATING HARVEST RATES OF BEARS FROM SEX RATIO CHANGES: BIAS AN
D VARIABILITY.

J. WILDL. MANAGE.

HARV MGMT DEMOG ANAL

,GEN , , ,

00464

HARRIS, R.B. AND L.H. METZGAR.

IN PRESSB
HARVEST AGE STRUCTURES AS INDICATORS OF DECLINE IN SMALL POPULATI
ONS OF GRIZZLY BEARS.

INT. CONF. BEAR RES. AND MANAGE. 7: .

HARV MGMT AGE/SEX DEMOG ANAL

,GEN , , ,

00465

HARRISON, J.L.

1958
RANGE OF MOVEMENT OF SOME MALAYAN RATS.

J. MAMMAL. 39(2):190-206.

HOME RNG

,GEN , , ,

00466

HARTHOORN, A.M.

1965
APPLICATION OF PHARMACOLOGICAL AND PHYSIOLOGICAL PRINCIPLES IN RE
STRAINT OF WILD ANIMALS.

WILDL. MONOGR. NO. 14:78 PP.

CAPTURE DRUGS

,GEN , , ,

00467

HARTING, A.L., JR.

1985
RELATIONSHIPS BETWEEN ACTIVITY PATTERNS AND FORAGING STRATEGIES O
F YELLOWSTONE GRIZZLY BEARS.

M.S. THESIS, MONT. STATE UNIV., BOZEMAN. 130 PP.

SENSE ACT PATT BEHAV PATT HAB EFFECT
GEN DATA PRED GARBAGE FOR STRAT
MGMT GEN
YGBE,IMW , , ,

00468

HARTKORN, F.

1966
BIG GAME SURVEYS AND INVESTIGATIONS - BLACKFOOT UNIT RECHECK.

FED. AID WILDL. REST. PROJ. W-72-R-11, JOB A-2. JOB COMPLETION RE
P., JULY 1, 1965-JUNE 30, 1966. MONT. FISH AND GAME DEP., HELENA.
47 PP..

HARV DATA

NCDE,MT , , ,

00469

HARTKORN, F.L. AND R. JANSON.

1974
BIG GAME SURVEY AND INVENTORY.

FED. AID WILDL. REST. PROJ. W-130-R-5, JOB NO. I-2. PROG. REP., JULY 1, 1973-JUNE 20, 1974. MONT. FISH AND GAME DEP., HELENA. 121 PP.

HARV DATA

,MT , , ,NCDE

00470

HARVEY, M.J. AND R.W. BARBOUR.

1965
HOME RANGE OF MICROTUS OCHROGASTER AS DETERMINED BY A MODIFIED MINIMUM AREA METHOD.

J. MAMMAL. 46(3):398-402.

HOME RNG

,GEN , , ,

00471

HASTINGS, B.C. AND B.K. GILBERT.

1981
AVERSIVE CONDITIONING OF BLACK BEARS IN THE BACKCOUNTRY OF YOSEMITE NATIONAL PARK.

PROC. CONF. SCI. RES. NATL. PARKS 2:294-303.

AVER COND NONMOT MGMT CAMP MGMT

,GEN , , ,

00472

HASTINGS, B.C., B.K. GILBERT AND D.L. TURNER.

1981
BLACK BEAR BEHAVIOR AND HUMAN-BEAR RELATIONSHIPS IN YOSEMITE NATIONAL PARK.

FINAL REP. PREP. FOR U.S.D.I., NATL. PARK SERV., WESTERN REGION, CONTRACT CX-1200-9-B051. PREP. BY UTAH COOP. RESOUR. STUDIES UNIT, UTAH STATE UNIV., LOGAN. 42 PP.

AVER COND NONMOT MGMT CAMP MGMT EDUC

,GEN , , ,

00473

HAYNE, D.W.

1949
CALCULATION OF SIZE OF HOME RANGE.

J. MAMMAL. 30(1):1-18.

HOME RNG

,GEN , , ,

00474

HAYNES, B.D. AND E. HAYNES.

1966
THE GRIZZLY BEAR - PORTRAITS FROM LIFE.

UNIV. OKLA. PRESS, NORMAN. 386 PP.

HIST ACCT

,GEN , , ,

C0475

HEBERT, D.M., D. EASTMAN AND H. LANGIN.

1983
AN EVALUATION OF CENSUS METHODS FOR GRIZZLY BEAR.

B.C. WILDL. BRANCH, VICTORIA. INTERNAL DRAFT REPORT. 13 PP.

CENSUS METH

,GEN , , ,

00476

HEBERT, D..M., D.W. LAY AND W.G. TURNBULL.

1980
IMMOBILIZATION OF COASTAL GRIZZLY BEARS WITH ETORPHINE HYDROCHLOR
IDE.

J. WILDL. DIS. 16(3):339-342.

DRUGS

BC-C,BC , , ,

00477

HECHTEL, J.

1977
THE FOOD HABITS AND HABITAT SELECTION OF A FEMALE GRIZZLY AND HER TWO YEARLINGS, BROOKS RANGE, ALASKA, MAY 28-SEPTEMBER 10, 1977.

MONT. COOP. WILDL. RES. UNIT, UNIV. MONT., MISSOULA. 8 PP.

FOOD CARCASS PRED HAB USE
MAP/TYPE

ARC ,AK ,NPR , ,WBRK

00478

HECHTEL, J.

1978
BEHAVIORAL ECOLOGY OF A BARREN-GROUND GRIZZLY BEAR FEMALE AND HER YOUNG IN THE NATIONAL PETROLEUM RESERVE - ALASKA.

PRELIMINARY REP. MONT. COOP. WILDL. RES. UNIT, UNIV. MONT., MISSO ULA. 11 PP.

MOVE HOME RNG DEN CHRON
MATERNAL HAB USE FOOD NUTR ANAL

ARC ,AK ,NPR , ,WBRK

00479

HECHTEL, J.L.

1985
ACTIVITY AND FOOD HABITS OF BARREN-GROUND GRIZZLY BEARS IN ARCTIC ALASKA.

M.S. THESIS, UNIV. MONTANA, MISSOULA. 74 PP.

ACT PATT FOOD FEED BEH PRED
MATERNAL

ARC ,AK ,NPR , ,WBRK

00480

HEDGE, R.S., G.E. FOLK, JR. AND M.C. BREWER.

1965
STUDIES ON WINTER LETHARGY OF BLACK AND GRIZZLY BEARS.

PROC. ALASKA SCI. CONF. 16:31-32.

HIB PHYS

,GEN , , ,

00481

HENDERSON, L.

1982
BEAR-HUMAN INTERACTIONS IN THE COMMERCIAL SALMON FISHING CAMPS AL
ONG THE YUKON RIVER.

YUKON WILDL. BRANCH, WHITEHORSE. 56 PP.

CAMP MGMT AVOID/ATTRAC

,YK , , ,YUKR

00482

HENRY, D. (CHAIRMAN).

1984
MINUTES OF TASK FORCE MEEETING RELATED TO BEAR PROOF STORAGE FACI
LITIES.

PREP. BY INTERAGENCY GRIZZLY BEAR COMM. TASK FORCE, U.S.D.I., INT
ERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN.. 20 PP

OUTFIT MGMT CAMP MGMT

,GEN , , ,

00483

HENSEL, R.J., D.L. SPENCER AND D.E. TRUDGEN.

1981
AN EVALUATION OF BROWN BEAR DENNING IN THE AREA OF THE PROPOSED T
ERROR LAKE HYDROELECTRIC PROJECT, KODIAK ISLAND, 1980.

PRES. AT 2ND CARNIVORE/FURBEARER RES. AND MANAGE. WORKSHOP, MARCH
11-12, 1981, UNIV. ALASKA, FAIRBANKS, AK., 19 PP.

DEN CHAR DEN SITE

AKKA,AK ,KNWR, ,TERL

00484

HENSEL, R.J., W.A. TROYER AND A.W. ERICKSON.

1969
REPRODUCTION IN THE FEMALE BROWN BEAR.

J. WILDL. MANAGE. 33(2):357-365.

REPRO PHYS BRD AGE COURT LITR SIZE
LITR FREQ

AKPN,AK , , ,

00485

HEPBURN, R.

1974
AN ELECTRIC FENCE CHARGER TO DISCOURAGE BEARS.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO.

DETER/REPEL

YGBE,IMW ,YNP , ,

00486

HERRERO, S.

1970
MAN AND THE GRIZZLY BEAR (PRESENT, PAST, BUT FUTURE?).

BIOSCIENCE 20(21):1148-1153.

HUMAN INJ MGMT GEN PUBLIC ATT RECR MGMT

,GEN , , ,

00487

HERRERO, S.

1970A
HUMAN INJURY INFLICTED BY GRIZZLY BEARS.

SCIENCE 170:593-598.

HUMAN INJ RECR MGMT REACTION GARBAGE
AVOID/ATTRAC

,GEN , , ,

00488

HERRERO, S.

1972
ASPECTS OF EVOLUTION AND ADAPTATION IN AMERICAN BLACK BEARS (URSU
S AMERICANUS PALLAS) AND BROWN AND GRIZZLY BEARS (U. ARCTOC LINNE
) OF NORTH AMERICA.

INT. CONF. BEAR RES. AND MANAGE. 2:221-231.

TAXON/EVOL

,GEN , , ,

C0489

HERRERO, S.

1976
CONFLICTS BETWEEN MAN AND GRIZZLY BEARS IN THE NATIONAL PARKS OF NORTH AMERICA.

INT. CONF. BEAR RES. AND MANAGE. 3:121-145.

HUMAN INJ AVOID/ATTRAC GARBAGE REACTION
MGMT GEN

,GEN , , ,

C0490

HERRERO, S.

1978A
PEOPLE AND GRIZZLY BEARS: THE CHALLENGE OF COEXISTENCE.

PP. 167-179 IN: WILDLIFE AND PEOPLE. PROC. OF JOHN S. WRIGHT FOR. CONF. 1978. DEP. OF FOR. AND NAT. RESOUR. AND COOP. EXT. SERV. PURDUE UNIV., WEST LAFAYETTE, INDIANA.

HUMAN INJ RECR MGMT MGMT GEN GARBAGE

,GEN , , ,

00491

HERRERO, S.

1978B
A COMPARISON OF SOME FEATURES OF THE EVOLUTION, ECOLOGY, AND BEHAVIOR OF BLACK AND GRIZZLY/BROWN BEARS.

CARNIVORE 1(1):7-17.

TAXON/EVOL MATERNAL FOOD REPRO
REP RATE TERR/SPACE PCP REG INTERSP COMP

,GEN , , ,

00492

HERRERO, S.

1979
BLACK BEARS: THE GRIZZLY'S REPLACEMENT?

PP. 179-195 IN: D. BURK, ED. THE BLACK BEAR IN MODERN NORTH AMERICA. PROC. WORKSHOP ON MANAGE. BIOL. OF NORTH AM. BLACK BEAR, 17-19 FEB. 1977, KALISPELL, MONT. BOONE AND CROCKETT CLUB AND CAMP FIRE CLUB OF AMERICA.

INTRASP BEH TAXON/EVOL WEIGHT INTERSP COMP
CANNIBAL

,GEN , , ,

00493

HERRERO, S.

1982
BEARS AND THE PROPOSED CANADIAN PACIFIC RAILWAY CONSTRUCTION CAMP
S IN GLACIER NATIONAL PARK, BRITISH COLUMBIA, DECEMBER, 1982.

PREP. FOR MACLARGEN PLANSEARCH CORP., VANCOUVER, B.C. PREP. BY BI
CS ENVIRON. RES. AND PLANNING ASSOC., LTD., CALGARY, ALBERTA. 47
PP.

HUMAN INJ	GARBAGE	ENERGY IMP	CONTROL
MORT DATA	CAMP MGMT	DETER/REPEL	

CR ,BC ,CGNP, ,

00494

HERRERO, S.M.

1985
BEAR ATTACKS - THEIR CAUSES AND AVOIDANCE.

WINCHESTER PRESS, PISCATAWAY, N.J. 287 PP.

HUMAN INJ	REACTION	GARBAGE	AVOID/ATTRAC
CAMP MGMT	RECR MGMT	GARB MGMT	INTRASP BEH
GEN BIOL			

,GEN , , ,

00495

HERRERO, S. AND D. HAMER.

1977
COURTSHIP AND COPULATION OF A PAIR OF GRIZZLY BEARS, WITH COMMENT
S ON REPRODUCTIVE PLASTICITY AND STRATEGY.

J. MAMMAL. 58(3):441-444.

COURT	COPULATE	REPRO
	WEAN	

CR ,BC ,BANP, ,

00496

HERRERO, S., W. MCCRORY AND B. PELCHAT.

IN PRESS
THE APPLICATION OF GRIZZLY BEAR HABITAT EVALUATION TO TRAIL AND C
AMPSITE LOCATIONS IN KANANASKIS PROVINCIAL PARK, ALBERTA.

INT. CONF. BEAR RES. AND MANAGE. 6.

HAB ANAL	NONMOT MGMT

CR ,AT ,KANP, ,

00497

HERROLD, J. AND J. BLYTHE.

1955
COMPILATIAN CF DATA ON WILDLIFE HARVEST.

FED. AID WILDL. REST. PROJ. W-3-R, WORK PLAN D. ALASKA DEP. FISH AND GAME, JUNEAU. 2 PP.

HARV DATA

,AK , , ,

00498

HEYWARD, P., R.G. WRIGHT AND E.E. KRUMPE.

1984A
GLACIER NATIONAL PARK BIOSPHERE RESERVE: A HISTORY OF SCIENTIFIC STUDY. VOL. 1: A NARRATIVE DESCRIPTION OF SCIENTIFIC STUDIES.

U.S. MAN AND THE BIOSPHERE PROGRAM, UNIV. IDAHO, MOSCOW. U.S. MAB REP. NO. 9. 137 PP.

GEN DATA	CENSUS/TREND	HUMAN INJ	POP EST
AVOID/ATTRAC	PUBLIC ATT	RECR IMP	RECR MGMT

NCDE,MT ,GLNP, ,

00499

HEYWARD, P., R.G. WRIGHT AND E.E. KRUMPE.

1984B
GLACIER NATIONAL PARK BIOSPHERE RESERVE: A HISTORY OF SCIENTIFIC STUDY. VOL. 2: BIBLIOGRAPHY, SUBJECT ANNOTATIONS, TABULAR DATA SU MMARIES, AND APPENDICES.

U.S. MAN AND THE BIOSPHERE PROGRAM, UNIV. IDAHO, MOSCOW. U.S. MAB REP. NO. 9. 199 PP.

BIBLIO

NCDE,MT ,GLNP, ,

C0500

HICKIE, P.

1953
INVENTORY OF BIG-GAME ANIMALS OF THE UNITED STATES, 1952.

U.S.D.I., FISH AND WILDL. SERV., WILDL. LEAFLET 348. 3 PP.

HIST DISTR HARV DATA

,GEN , , ,

00501

HICKMAN, J.

1982
REGION ONE - STRATEGIC PLAN, NCNGAME.

WASH. DEP. GAME, SPOKANE. 15 PP.

MGMT GEN

,WA , , ,

00502

HICKMAN, J.

1984
IDENTIFYING WASHINGTON'S BEARS.

WASH. WILDL. 1984(DEC.):11-12.

IDENT/RECOG EDUC MARK

,WA , , ,

00503

HICKMAN, J.

1985
GUIDELINES FOR THE REPORTING OF GRIZZLY BEAR OBSERVATIONS FOR THE SELKIRK ECOSYSTEM.

WASH. DEP. GAME, SPOKANE. 6 PP.

MONIT SYS

,WA , , ,

00504

HICKS, L.L.

1985
MULTIPLE-USE ON WESTERN PRIVATE INDUSTRIAL TIMBERLANDS.

TRANS. NORTH AM. WILDL. AND NAT. RESOUR. CONF. 50:211-214.

MGMT GEN

,US , , ,

00505

HILLIS, M.

1986
ENHANCING GRIZZLY BEAR HABITAT THROUGH TIMBER HARVESTING.

PP. 176-179 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

TIMB-POST   TIMB-METH   TIMB-HAB

CYNC,MT ,LONF, ,

00506

HINMAN, R.

1974
THE IMPACT OF OIL DEVELOPMENT ON WILDLIFE POPULATIONS IN NORTHERN ALASKA.

PROC. ANNU. CONF. WEST. ASSOC. STATE GAME & FISH COMM. 54:156-164.

ENERGY IMP

ARC ,AK , , ,

00507

HINMAN, R., (ED.)

1977
SURVEY-INVENTORY ACTIVITIES, PART II. BLACK BEAR, BROWN BEAR, POLAR BEAR, CARIBOU.

FED. AID WILDL. REST. PROJ. W-17-8, JOBS NO. 3, 4, 5, 17 AND 22. ANNU. REP., VOL. VII. ALASKA DEP. FISH AND GAME, JUNEAU. 156 PP.

HARV DATA   SKULL   MISC QUANT   AGE/SEX
GARB MGMT

,AK , , ,

00508

HINMAN, R.A. (ED.).

1978
SURVEY-INVENTORY ACTIVITIES, PART II. BLACK BEAR, BROWN BEAR, POLAR BEAR, CARIBOU.

FED. AID WILDL. REST. PROJ. W-17-9, JOB NOS. 3, 4, 5, 17 AND 22. ANNU. REP., VOL VIII. ALASKA DEP. FISH AND GAME, JUNEAU. 190 PP.

HARV DATA   MEAS/QUANT   SKULL   AGE/SEX
LITR SIZE   MORT DATA

,AK , , ,

00509

HINMAN, R. (ED.).

1979
SURVEY-INVENTORY ACTIVITIES, PART I. BLACK BEAR, BROWN BEAR, POLA
R BEAR, CARIBOU.

FED. AID. WILDL. REST. PROJ. W-17-11, JOB NOS 17.0, 4.0 AND 22.0.
ANNU. REP., VOL. X. ALASKA DEP. FISH AND GAME, JUNEAU. 115 PP.

HARV DATA	MEAS/QUANT	SKULL	PRED
MORT DATA	AGE/SEX	LITR SIZE	

,AK , , ,

00510

HINMAN, R., (ED.)

1982
SURVEY-INVENTORY ACTIVITIES, PART I. BLACK BEARS AND BROWN BEARS.

FED. AID WILDL. REST. PROJ. W-19-2 AND W-22-1, JOB NOS. 17.0 AND
4.0. ANNU. REP., VOL. XIII. ALASKA DEP. FISH AND GAME, JUNEAU. 93
PP. AND GAME, JUNEAU. 156 PP.

HARV DATA	GARBAGE	CENSUS/TREND	AGE/SEX
SKULL	HARV MGMT		

,AK , , ,

00511

HOAK, J.H. AND T.W. CLARK.

1979
THE STATUS OF GRIZZLY BEARS IN BRIDGER-TETON NATIONAL FOREST, WYO
MING.

FINAL REP. WEST. ENVIRON. RES. ASSOC., POCATELLO, IDAHO. 39 PP.

DISTR	CENSUS/TREND	POP EST	FOOD
HAB USE	OUTFIT MGMT	GARBAGE	CAMP MGMT

YGBE,WY ,BTNF, ,

00512

HOAK, J.H., T.W. CLARK AND J.L. WEAVER.

1983
OF GRIZZLY BEARS AND COMMERCIAL OUTFITTERS IN BRIDGER-TETON NATIO
NAL FOREST, WYOMING.

INT. CONF. BEAR RES. AND MANAGE. 5:110-117.

PRES DISTR	CAMP MGMT	OUTFIT MGMT	DEPRED

YGBE,WY ,BTNF, ,

00513

HOAK, J.H., T.W. CLARK AND B. WOOD.

1981
GRIZZLY BEAR DISTRIBUTION, GRAND TETON NATIONAL PARK AREA, WYOMIN
G.

NORTHWEST SCI. 55(4):245-247.

DISTR

YGBE,WY ,JDR ,GTNP,

00514

HODGSON, R.W.

1974
SOME EFFECTS OF THREAT APPEAL IN MESSAGES ABOUT HAZARDS OF GRIZZL
Y BEARS IN NATIONAL PARKS: AN EXPERIMENT.

PH.D. DISS., MICH. STATE UNIV., LANSING.

RECR MGMT EDUC PUBLIC ATT

,GEN , , ,

00515

HOLCROFT, A.C. AND S. HERRERO.

1984
GRIZZLY BEAR DIGGING SITES FOR HEDYSARUM SULPHURESCENS ROOTS IN S
OUTHWESTERN ALBERTA.

CAN. J. ZOOL. 62(12):2571-2475.

FOOD FEED BEH HAB SAMPL

CR ,AT ,KANP, ,

00516

HOLLAND, T.M.

1986
GRIZZLY BEAR HABITAT IMPROVEMENT PROJECTS ON THE SOUTH AND MIDDLE
FORK FLATHEAD RIVER.

PP. 190-194 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-G
RIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTA
IN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

FIRE MGMT TIMB-POST ROAD MGMT

NCDE,MT ,FLNF, ,

00517

HOREJSI, B.L.

1986A
INDUSTRIAL AND AGRICULTURAL INCURSION INTO GRIZZLY BEAR HABITAT: THE ALBERTA STORY.

PP. 116-123 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

POL/ADM MGMT	AGR IMP/MGT	TIMB IMP	ENERGY IMP
MORT DATA	HARV MGMT	ENERGY MGMT	MGMT GEN

CR ,AT , , ,

00518

HOREJSI, B.L.

1986B
STATUS OF THE GRIZZLY BEAR IN THE SOUTH CASTLE-WATERTON LAKES NATIONAL PARK REGION OF ALBERTA.

WEST. WILDL. ENVIRON. CONSULTING LTD., CALGARY. 28 PP.

ENERGY IMP	ROAD IMP	HARV DATA	POACH/ILLEG
AGE/SEX	TIMB IMP	SUBDIV MGMT	AGR IMP/MGT

CR ,AT ,WANP, ,

00519

HOREJSI, B.L. AND R.M. RAINE.

1983
AN INVESTIGATION OF THE DISTRIBUTION, MOVEMENTS, AND ACTIVITIES OF GRIZZLY BEARS IN THE SOUTH WAPITI REGION OF ALBERTA. YEAR THREE.

PROGR. REP. NO. 3. WEST. WILDL. ENVIRON. CONSULTING LTD., CALGARY. 56 PP.

PRES DISTR	MOVE	HOME RNG	BEHAV PATT
FOOD			

CR ,AT , , ,SWAP

00520

HOREJSI, B.L. AND G. SLATTER.

1982
AN INVESTIGATION OF THE DISTRIBUTION, MOVEMENTS, AND ACTIVITIES OF GRIZZLY BEARS IN THE SOUTH WAPITI REGION OF ALBERTA. YEAR TWO.

PROGR. REP. NO. 2. WEST. WILDL. ENVIRON. CONSULTING LTD., CALGARY. 38 PP.

PRES DISTR	MOVE	HOME RNG	BEHAV PATT
FOOD			

CR ,AT , , ,SWAP

00521

HOREJSI, B.L. AND L.R. STEGENGA.

1981
AN INVESTIGATION OF THE DISTRIBUTION, MOVEMENTS AND ACTIVITIES OF GRIZZLY BEARS IN THE PINTO CREEK-MUDDY CREEK AREA OF ALBERTA. YE AR ONE.

PROGR. REP. NO. 1. WEST. WILDL. ENVIRON. CONSULTING LTD., CALGARY .

PRES DISTR MOVE HOME RNG BEHAV PATT
FOOD

CR ,AT , , ,SWAP

00522

HORNOCKER, M.G.

1962
POPULATION CHARACTERISTICS AND SOCIAL AND REPRODUCTIVE BEHAVIOR O F THE GRIZZLY BEAR IN YELLOWSTONE NATIONAL PARK.

M.S. THESIS, MONT. STATE UNIV., MISSOULA. 94 PP.

MATERNAL ORPHAN COPULATE COURT
CENSUS/TREND SEAS BEH AGE/SEX INTRASP BEH

YGBE,WY ,YNP , ,TRCU

00523

HOSKINS, W.P.

1974
YELLOWSTONE LAKE TRIBUTARY SURVEY PROJECT.

DRAFT REP. U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN , MONT. 11 PP.

PRED

YGBE,WY ,YNP , ,LAKE

00524

HOSKINS, W.P.

1975
YELLOWSTONE LAKE TRIBUTARY STUDY.

1975 SUMMER REP. U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, B OZEMAN, MONT. 31 PP.

PRED RECR IMP FEED BEH

YGBE,WY ,YNP , ,LAKE

00525

HOUSTON, D.B.

1978
ELK AS WINTER-SPRING FOOD FOR CARNIVORES IN NORTHERN YELLOWSTONE NATIONAL PARK.

J. APPL. ECOL. 15(3):653-661.

CARCASS FOOD

YGBE,IMW ,YNP , ,

00526

HOUSTON, D.B.

1982
ELK-CARNIVORE RELATIONSHIPS.

CHAPTER 11, PP. 186-195 IN: D. HOUSTON. THE NORTHERN YELLOWSTONE ELK. ECOLOGY AND MANAGEMENT. MACMILLAN PUBLISHING CO., INC., N.Y.

CARCASS PRED

YGBE,IMW ,YNP , ,

00527

HOWELL, A.H.

1940
BROWN BEAR KILLED ON ST. LAWRENCE ISLAND.

J. MAMMAL. 21(2):216.

HIST DISTR HIST ACCT

,AK , , ,

00528

HUNT, C.L.

1982
BEAR ACTIVITY - WEST GLACIER DUMPSTER SITE AND SURROUNDING AREA-SUMMER AND FALL, 1981.

MONT. COOP. WILDL. RES. UNIT, UNIV. MONT., MISSOULA. 6 PP.

GARBAGE

NCDE,MT , , ,WGLA

C0529

HUNT, C.L.

1983
DETERRENTS, AVERSIVE CONDITIONING, AND OTHER PRACTICES: AN ANNOTA
TED BIBLIOGRAPHY TO AID IN BEAR MANAGEMENT.

MONT. COOP. WILDL. RES. UNIT, UNIV. MONT., MISSCULA. 136 PP.

BIBLIO DETER/REPEL AVER COND

,GEN , , ,

00530

HUNT, C.L.

1984
BEHAVIORAL RESPONSES OF BEARS TO TESTS OF REPELLENTS, DETERRENTS,
AND AVERSIVE CONDITIONING.

M.S. THESIS, UNIV. MONT., MISSOULA. 274 PP.

DETER/REPEL AVER COND RELOC

,GEN , , ,

00531

HUNT, C.

1985
DESCRIPTION OF FIVE PROMISING DETERRENT AND REPELLENT PRODUCTS FO
R USE ON BEARS.

FINAL REP. PREP. FOR U.S.D.I., FISH AND WILDL. SERV., OFFICE OF
GRIZZLY BEAR COORDINATOR, MISSCULA, MONT. 55 PP.

DETER/REPEL AVER COND

,GEN , , ,

00532

HUNT, C. AND C. JONKEL.

1981
BEAR DETERRENT TESTS.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 56. 1
3 PP.

DETER/REPEL AVER COND REACTION

,GEN , , ,

00533

HUNTER, R.G. AND J.R. GUNSON.

1980
ANALYSIS OF GRIZZLY BEAR COMPLAINTS IN ALBERTA: 1970-79.

ALBERTA FISH AND WILDL. DIV., EDMONTON. 12 PP.

CONTROL DEPRED HUMAN INJ RELOC
CAMP MGMT ENERGY IMP

,AT , , ,

00534

HUSBY, P., S. MEALEY AND C. JONKEL.

1977
SEASONAL FOOD HABITS OF GRIZZLY BEARS (URSUS ARCTOS HORRIBILIS ORD) IN NORTHWESTERN MONTANA.

PP. 103-117 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. ANNU. REP. NO. 2.

FOOD

NCDE,MT , , ,

00535

INUKAI, T.

1969
METABOLISM OF STRYCHNINE NITRATE APPLIED FOR THE CONTROL OF THE BEAR.

RESIDUE REV. 25:315-318.

CONTROL POISON

,GEN , , ,

00536

IRVING, L. AND J. KROG.

1954
BODY TEMPERATURES OF ARCTIC AND SUBARCTIC BIRDS AND MAMMALS.

J. APPL. PHYSIOL. 6(11):667-680.

TEMP

,AK , , ,

C0537

JACOBSEN, R.D.

1980
LEGAL ASPECTS OF CRITICAL HABITAT DETERMINATIONS.

INT. CONF. BEAR RES. AND MANAGE. 4:5-8.

LEGAL ZONING MGMT GEN

,US , , ,

00538

JACOBSON, P.

1981
PRELIMINARY SURVEY FOR GRIZZLY BEAR HABITAT IN THE VICINITY OF TH
E LAKE LOUISE SKI AREA.

PARKS CANADA, BANFF NATL. PARK, ALBERTA. 47 PP.

HAB RECON

CR ,AT ,BANP, ,LOUI

00539

JACZEWSKI, Z., J. GILL AND S. KOZNIEWSKI.

1960
CAPACITY OF THE DIFFERENT PARTS OF THE DIGESTIVE TRACT IN THE BRO
WN BEAR.

TRANS. INT. UNION GAME BIOL. 4:146-154.

DIGEST MORPH/PHYS

,GEN , , ,

C0540

JANSON, R.G.

1967
BIG GAME SURVEYS AND INVESTIGATIONS, DISTRICT-WIDE.

FED. AID WILDL. REST. PROJ. W-72-R-12, JOB A-1. JOB COMPLETION RE
P., JULY 1, 1966-JUNE 30, 1967. MCNT. FISH AND GAME DEP., HELENA
. 48 PP.

HARV DATA

NCDE,MT , , ,

00541

JANSON, R.G.

1974
BIG GAME SURVEY AND INVENTORY.

PP. 2-13 IN: STATEWIDE WILDLIFE SURVEY AND INVENTORY-REGION 2. FED. AID WILDL. REST. PROJ. W-130-R-4, JOB NO. I-2. PROG. REP., JULY 1, 1972-JUNE 30, 1973. MONT. FISH AND GAME DEP., HELENA.

HARV DATA

NCDE,MT , , ,

00542

JENNESS, R., A.W. ERICKSON AND J.J. CRAIGHEAD.

1972
SOME COMPARATIVE ASPECTS OF MILK FROM FOUR SPECIES OF BEARS.

J. MAMMAL. 53(1):34-47.

MORPH/PHYS REPRO PHYS

,GEN , , ,

00543

JENNRICH, R.I. AND F.B. TURNER.

1969
MEASUREMENT OF NON-CIRCULAR HOME RANGE.

J. THEORET. BIOL. 22:227-237.

HOME RNG

,GEN , , ,

00544

JESSUP, D.A. AND D.B. KOCH.

1984
SURGICAL IMPLANTATION OF A RADIOTELEMETRY DEVICE IN WILD BLACK BEARS, URSUS AMERICANUS.

CALIF. FISH AND GAME 70(3):163-166.

TELEM

,GEN , , ,

00545

JOHNSON, L.

1980
BROWN BEAR MANAGEMENT IN SOUTHEASTERN ALASKA.

INT. CONF. BEAR RES. AND MANAGE. 4:263-270.

HARV MGMT HARV DATA HUMAN IMP

AKSE,AK , , ,ADIS

00546

JOHNSON, L.J. AND P. LEROUX.

1973
AGE OF SELF-SUFFICIENCY IN BROWN/GRIZZLY BEAR IN ALASKA.

J. WILDL. MANAGE. 37(1):122-123.

ORPHAN WEAN

AK-I,AK , , ,

00547

JOHNSON, R. AND C. JONKEL.

1976
A STUDY OF SUBDIVISIONS AND SIMILAR DEVELOPMENTS IN GRIZZLY HABIT
AT.

PP. 35-39 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ.,
UNIV. MONT., MISSOULA. ANNU. REP. NO. 1.

SUBDIV MGMT

NCDE,MT , , ,

00548

JOHNSON, R. AND C. JONKEL.

1977
A STUDY OF SUBDIVISIONS AND SIMILAR DEVELOPMENTS IN THE RANGE OF
THE BORDER GRIZZLIES.

PP. 118-129 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ
., UNIV. MONT., MISSOULA. ANNU. REP. NO. 2.

SUBDIV MGMT

NCDE,MT , , ,

C0549

JOHNSON, S.

1979
MEMORANDUM REGARDING POTENTIAL HAZARDS TO GRIZZLY BEARS FROM STRY
CHNINE POISONING.

U.S.D.A., FOREST SERV., TARGHEE NATL. FOREST, ST. ANTHONY, IDAHO.
 2 PP.

POISON

,GEN , , ,

C0550

JOHNSON, S.J. AND D.E. GRIFFEL.

1982
SHEEP LOSSES ON GRIZZLY BEAR RANGE.

J. WILDL. MANAGE. 46(3):786-790.

DEPRED CONTROL FEED BEH LIVESTK MGMT

YGBE,ID ,TANF, ,

00551

JOLLY, G.M.

1965
EXPLICIT ESTIMATES FROM CAPTURE-RECAPTURE DATA WITH BOTH DEATH AN
D IMMIGRATION - STOCHASTIC MODEL.

BIOMETRIKA. 52:225-247.

CENSUS METH
GEN BIOL

,GEN , , ,

00552

JONKEL, C.

1960
BLACK BEAR POPULATION STUDIES.

FED. AID WILDL. REST PROJ. W-49-R-9, JOB IV-A. JOB COMPLETION REP
., MAY 1, 1959-APR. 30, 1960. MONT. FISH AND GAME DEP., HELENA. 2
2 PP.

DRUGS

NCDE,MT , , ,WHR

00553

JONKEL, C.

1976
RECURRENT PROBLEMS IN GRIZZLY MANAGEMENT.

PP. 40-48 IN: C. JONKEL, ED. ANNUAL REPORT NO. 1. BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA.

GARB MGMT HUMAN IMP MORT DATA

NCDE,MT , , ,

00554

JONKEL, C.

1978
GRIZZLY BEARS AND THE MOUNTAIN PINE BEETLE.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 21. 3 PP.

TIMB MGMT BTLE MGMT

,GEN , , ,

00555

JONKEL, C.

1980A
THE ANTELOPE BUTTE—BLACKLEAF AREA AND OIL DEVELOPMENT.

BORDER GRIZZLY PROJ., UNIV. OF MONT., MISSOULA. SPEC. REP. NO. 42. 10 PP.

HAB USE MGMT GEN ROAD IMP TIMB MGMT
ROAD MGMT

NCDE,MT , , ,ANBU

00556

JONKEL, C.

1980B
WINTER DISTURBANCE AND GRIZZLY BEARS.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 46. 3 PP.

DEN RECR IMP MOTOR IMP

NCDE,MT , , ,

00557

JONKEL, C.

1980C
BGP RESEARCH PAPERS, AGENCY REPORTS, WORKING PAPERS AND THESES, 1
975-1981.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. 11 PP.

BIBLIO

,GEN , , ,

00558

JONKEL, C.

1982A
FIVE YEAR SUMMARY REPORT.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 60. 2
77 PP.

GEN DATA　TYPE DESCRIP　FOR STRAT　TIMB MGMT
ROAD MGMT　LIVESTK MGMT　AGE/SEX　FOOD
HAB USE
NCDE,MT , , ,

00559

JONKEL, C.

1982B
AN AVERSIVE CONDITIONING AND RE-INTRODUCTION PROGRAM FOR GRIZZLIE
S NOS. 530 AND 531.

BORDER GRIZZLY PROJ., UNIV. OF MONT., MISSOULA. SPEC. REP. NO. 62
. 15 PP.

AVER COND　RELOC

CYE ,MT , , ,CAB

00560

JONKEL, C.

1984A
GRIZZLY BEAR HABITAT COMPONENTS IN THE BORDER GRIZZLY AREA.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 67. 9
PP.

MAP/TYPE

NCDE,MT , , ,

00561

JONKEL, C.

1984B
GRIZZLIES AND BLACK BEAR INTERRELATIONSHIPS.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 70. 6
PP.

INTERSP COMP

NCDE,MT , , ,NFLT

00562

JONKEL, C.

1985
THE WARINESS OF HUNTED GRIZZLY POPULATIONS VS NON-HUNTED POPULATI
ONS.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 73. 7
PP.

HARV IMP REACTION

,GEN , , ,

C0563

JONKEL, C., T. BUMGARNER AND L.C. LEE.

1981
GRIZZLY BEARS AND THE NORTH FORK OF THE FLATHEAD RIVER FLOOD PLAI
N.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 54. 4
8 PP.

PRES DISTR HAB USE MORT DATA TYPE DESCRIP
COVER ROAD IMP ROAD MGMT HOME RNG
MAP/TYPE
NCDE,MT , , ,NFLT

00564

JONKEL, C. AND I.M. COWAN.

1971
THE BLACK BEAR IN THE SPRUCE-FIR FOREST.

WILDL. MONOGR. NO. 27. 57 PP.

INTERSP COMP

NCDE,MT ,FLNF, ,WHR

00565

JONKEL, C. AND K.R. GREER.

1975
BLOOD AND TISSUE COLLECTION, AND TOXIC CHEMICAL ANALYSIS TECHNIQU
ES.

BORDER GRIZZLY TECH. COMM., BORDER GRIZZLY PROJ., UNIV. MONT., MI
SSOULA. WORKING PAP. NO. 5. 6 PP.

HEMAT PARAS/DIS RES TECH

,GEN , , ,

00566

JONKEL, C.J. AND D. HADDEN.

1986
GRIZZLY BEAR HABITAT RESEARCH NEEDS IN THE BORDER GRIZZLY AREA.

PP. 124-127 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-G
RIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTA
IN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

MGMT GEN

NCDE,MT , , ,

00567

JONKEL, C., P. HUSBY, R. RUSSELL AND J. BEECHAM.

1980
THE REINTRODUCTION OF ORPHANED GRIZZLY BEAR CUBS INTO THE WILD.

INT. CONF. BEAR RES. AND MANAGE. 4:369-372.

ORPHAN RES TECH RELOC INT/REINT

NCDE,MT , , ,

00568

JONKEL, C., S. KISER AND D.B. ROCKWELL.

1977
STATUS OF THE MEXICAN GRIZZLY.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 6. 26
PP.

HIST DISTR HUMAN IMP MORT DATA PRES DISTR

,SWMX, , ,

00569

JONKEL, C. AND L. KLASSEN.

1985
TISSUE IMPACTS OF THE "BEAR THUMPER."

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 76. 5 PP.

DETER/REPEL

,GEN , , ,

00570

JONKEL, C., L. LEE, T. THIER, N. MCMURRAY AND R. MACE.

1979
SULLIVAN CREEK GRIZZLIES.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 23. 10 PP.

MORT DATA TIMB MGMT TIMB IMP PRES DISTR
HAB USE MGMT GEN

NCDE,MT ,SLCK, ,

00571

JONKEL, C., L.C. LEE, P. ZAGER, A. SCHALLENBERGER, C.W. SERVHEEN AND R. MACE.
N.D.
GRIZZLY BEAR-LIVESTOCK COMPETITION IN RIPARIAN AREAS.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. 25 PP.

LIVESTK IMP FOOD

NCDE,MT , , ,

00572

JONKEL, C., N. MCMURRAY, J. PERRY, P. ZAGER AND M. HAROLDSON.

1978
BARK BEETLES, TIMBER SALVAGE AND THE GRIZZLY BEAR AT GLACIER VIEW RANGER DISTRICT, U.S.FOREST SERV., COLUMBIA FALLS, MONTANA.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 12. 21 PP.

TIMB MGMT URBAN DEV TIMB IMP TIMB-METH
TIMB-POST

NCDE,MT ,FLNF, ,NFLT

00573

JONKEL, C., S. MEALEY AND G. JOSLIN.

1976
DELINEATION OF GRIZZLY HABITAT IN THE BORDER GRIZZLY AREA.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 3. 22 PP.

ZONING MGMT GEN

NCDE,MT , , ,

00574

JONKEL, C. AND F.L. MILLER.

1970
RECENT RECORDS OF BLACK BEARS (URSUS AMERICANUS) ON THE BARREN GROUNDS OF CANADA.

J. MAMMAL. 51(4):826-828.

INTERSP COMP

,ECAN, , ,

00575

JOPE, K.M.

1982
INTERACTIONS BETWEEN GRIZZLY BEARS AND HIKERS IN GLACIER NATIONAL PARK, MONTANA.

FINAL REP. PREP. FOR U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. PREP. BY COOP. PARK STUDIES UNIT, OREGON STATE UNIV., CORVALLIS. REP. 82-1. 62 PP.

TAXON/EVOL INTRASP BEH HUMAN INJ NONMOTOR IMP
AVOID/ATTRAC REACTION NCNMOT MGMT MATERNAL

NCDE,MT ,GLNP, ,

00576

JOPE, K.L.M.

1983A
HABITUATION OF GRIZZLY BEARS TO PEOPLE: A HYPOTHESIS.

INT. CONF. BEAR RES. AND MANAGE. 5:322-327.

REACTION

NCDE,MT ,GLNP, ,

00577

JOPE, K.L.

1983B
RESEARCH ON INTERACTIONS BETWEEN BACKPACKERS AND GRIZZLY BEARS IN DENALI NATIONAL PARK AND PRESERVE.

PROGR. REP. U.S.D.I., DENALI NATL. PARK AND PRESERVE, ALASKA. 15 PP.

HUMAN INJ   REACTION   NONMOT MGMT   AVER COND
DETER/REPEL   CAMP MGMT

AK-I,AK ,DENP, ,

00578

JOPE, K.L.

1984
RESEARCH ON INTERACTIONS BETWEEN BACKPACKERS AND GRIZZLY BEARS IN DENALI NATIONAL PARK AND PRESERVE.

SUPPL. TO 1982 PROGR. REP. U.S.D.I., DENALI NATL. PARK AND PRESERVE, ALASKA. 26 PP.

REACTION   NONMOT MGMT   AVOID/ATTRAC   CAMP MGMT

AK-I,AK ,DENP, ,

C0579

JOPE, K.

1985
IMPLICATIONS OF GRIZZLY BEAR HABITUATION TO HIKERS.

WILDL. SOC. BULL. 13(1):32-37.

REACTION   AVOID/ATTRAC   HUMAN INJ   NONMOT MGMT
NONMOTOR IMP

NCDE,MT ,GLNP, ,

00580

JOPE, K.L. AND L.B. CASEBEER.

1983
BROWN BEAR POPULATION SURVEY, KATMAI NATIONAL PARK AND PRESERVE.

U.S.D.I., NATL. PARK SERV., KATMAI NATL. PARK, ALASKA. 3 PP.

CENSUS/TREND   CENSUS METH

AKPN,AK ,KANM, ,

00581

JOPE, K.L. AND B. SHELBY.

1984
HIKER BEHAVIOR AND THE OUTCOME OF INTERACTIONS WITH GRIZZLY BEARS

LEISURE SCI. 6(3):257-270.

PUBLIC ATT	REACTION	NONMOTOR IMP	AVOID/ATTRAC

NCDE,MT ,GLNP, ,

00582

JORGENSEN, C.

1979
BEAR-LIVESTOCK INTERACTIONS, TARGHEE NATIONAL FOREST.

M.S. THESIS, UNIV. MONT., MISSOULA. 162 PP.

DEPRED	LIVESTK IMP	RES MORT	HOME RNG
DRUGS	HAB USE	FOOD	INTERSP COMP

YGBE,IDWY,TANF, ,

00583

JORGENSEN, C.J.

1983
BEAR-SHEEP INTERACTIONS, TARGHEE NATIONAL FOREST.

INT. CONF. BEAR RES. AND MANAGE. 5:191-200.

INTERSP COMP	LIVESTK IMP	LIVESTK MGMT

YGBE,ID ,TANF, ,

00584

JOSLIN, G.

1977
THE GREAT BEAR WILDERNESS AND ITS IMPLICATIONS FOR GRIZZLY BEARS.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 5. 6 PP.

PRES DISTR	ENERGY MGMT

NCDE,MT ,FLNF, ,

00585

JOSLIN, G. AND J. KAPLER.

1980
A COMPUTERIZED SYSTEM FOR RECORDING AND RECALLING GRIZZLY BEAR RE PORTS.

INT. CONF. BEAR RES. AND MANAGE. 4:33-36.

MONIT SYS

NCDE,MT , , ,

00586

JOSLIN, G. AND N. MCMURRAY.

1977
GRIZZLY BEAR REPORTS FROM WITHIN THE BORDER GRIZZLY AREA - 1976.

PP. 23-38 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. ANNU. REP. NO. 2.

PRES DISTR

NCDE,MT , , ,

C0587

JOSLIN, G., N. MCMURRAY, T. WERNER, S. KISER AND C. JONKEL.

1977
GRIZZLY BEAR RESPONSE TO HABITAT DISTURBANCE.

PP. 39-98 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. ANNU. REP. NO. 2.

MAP/TYPE HAB USE MEAS/QUANT MOVE
HOME RNG DEN SITE HAB EFFECT TIMB-METH
AGE/SEX
NCDE,MT , , ,SFLT

00588

JOSLIN, G., J. TITUS AND C. JONKEL.

1976
PAST AND PRESENT DISTRIBUTION OF THE BORDER GRIZZLY BEARS.

PP. 51-67 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. ANNU. REP. NO. 1.

DISTR

NCDE,MT , , ,

00589

JUDD, S. AND R. KNIGHT.

1977
DETERMINATION AND ANALYSIS OF GRIZZLY BEAR MOVEMENT PATTERNS USIN
G BIOTELEMETRY.

IN: 1ST INT. CONF. ON WILDL. BIOTELEMETRY, 27-19 JULY 1977, LARAM
IE, WYO.

MOVE HOME RNG

YGBE,IMW , , ,

00590

JUDD, S. AND R.R. KNIGHT.

1980
MOVEMENTS OF RADIO-INSTRUMENTED GRIZZLY BEARS WITHIN THE YELLOWST
ONE AREA.

INT. CONF. BEAR RES. AND MANAGE. 4:359-367.

MOVE HOME RNG

YGBE,IMW , , ,

00591

JUDD, S. AND R. KNIGHT AND B. BLANCHARD.

IN PRESS
DENNING OF GRIZZLY BEARS IN THE YELLOWSTONE AREA.

INT. CONF. BEAR RES. AND MANAGE. 6.

DEN CHRON DEN CHAR DEN SITE HAB USE

YGBE,IMW , , ,

00592

KASWORM, W., G. BROWN AND A. OLSEN.

1983
CABINET MOUNTAINS GRIZZLY BEAR STUDY.

ANNU. REP. JUNE-DEC. 1983. PREP. FOR U.S.D.I., FISH AND WILDL. SE
RV. PREP. BY MONT. DEP. FISH, WILDL., AND PARKS, HELENA. 16 PP.

MEAS/QUANT MOVE DEN SITE DEN CHRON

CYE ,IDMT, , ,

00593

KASWORM, W.

1984
CABINET MOUNTAINS GRIZZLY BEAR STUDY.

ANNU. REP. APRIL 1983-MARCH 1984. PREP. FOR U.S.D.I., FISH AND WI
LDL. SERV. PREP. BY MONT. DEP. FISH, WILDL., AND PARKS, HELENA. 5
0 PP.

DISTR MEAS/QUANT MOVE HOME RNG
HAB USE

CYE ,IDMT, , ,

00594

KASWORM, W.

1985
CABINET MOUNTAINS GRIZZLY BEAR STUDY.

1984 ANNU. PROGR. REP. PREP. FOR U.S.D.I., FISH AND WILDL. SERV.
PREP. BY MONT. DEP. FISH, WILDL. AND PARKS, HELENA. 81 PP.

DISTR HARV DATA MEAS/QUANT HOME RNG
MOVE HAB USE ROAD IMP NONMOTOR IMP

CYE ,IDMT, , ,

00595

KAYE, R.

1982
BEAR/HUMAN INTERACTIONS. A BACKGROUND PAPER FOR THE FOUR MOUNTAIN
PARK PLANNING PROGRAM.

PARKS CANADA, JASPER NATL. PARK, ALBERTA. 31 PP.

HUMAN INJ GARBAGE GARB MGMT EDUC
LEGAL CLOSURE CONTROL RECR MGMT
REACTION
CR ,ATBC,PC , ,

C0596

KEATING, K.A.

1983
TRENDS IN GRIZZLY BEAR NUMBERS AND BEHAVIOR (1910-1980) RELATIVE
TO SIGHTING AND CONFRONTATION RATES IN GLACIER NATIONAL PAR
K, MONTANA.

U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 44 PP.

HUMAN INJ POP EST CENSUS/TREND
REACTION

NCDE,MT ,GLNP, ,

00597

KEATING, K.A.

1986
HISTORICAL GRIZZLY BEAR TRENDS IN GLACIER NATIONAL PARK, MONTANA.

WILDL. SOC. BULL. 14:83-87.

CENSUS/TREND   REACTION

NCDE,MT ,GLNP, ,

00598

KEMP, G.A.

1976
THE DYNAMICS AND REGULATION OF BLACK BEAR, URSUS AMERICANUS, POPU
LATIONS IN NORTHERN ALBERTA.

INT. CONF. BEAR RES. AND MANAGE. 3:191-198.

POP REG

,GEN , , ,

C0599

KENDALL, K.

1977
BIBLIOGRAPHY OF BEAR LITERATURE.

U.S.D.I., NATL. PARK SERV., DIV. OF RES. AND SCI. SERV. WASHINGTO
N, D.C. 8 PP.

BIBLIO

,GEN , , ,

00600

KENDALL, K.C.

1980
FOOD HABITS OF YELLOWSTONE GRIZZLY BEARS, 1978 AND 1979.

PP. 24-34 IN: R.R. KNIGHT, B.M. BLANCHARD, K.C. KENDALL AND L.E.
OLDENBURG, EDS. YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS. U.S.D.I.
, INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 91 PP.

FOOD   SCAT ANAL   FEED BEH   CARCASS

YGBE,IMW , , ,

00601

KENDALL, K. C.

1981
BEAR USE OF PINE NUTS.

M.S. THESIS, MONT. STATE UNIV., BOZEMAN. 27 PP.

FOOD FEED BEH HAB USE INTERSP COMP

YGBE,MTWY, , ,

C0602

KENDALL, K.C.

1983A
GRIZZLY BEAR POPULATION TREND STUDIES, APGAR MOUNTAINS, GLACIER N
ATIONAL PARK, 1982 PROGRESS REPORT.

U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 19 PP.

CENSUS/TREND CENSUS METH AGE/SEX LITR SIZE
BURN USE/MGT FOOD

NCDE,MT ,GLNP, ,APGR

C0603

KENDALL, K.C.

1983B
USE OF PINE NUTS BY GRIZZLY AND BLACK BEARS IN THE YELLOWSTONE AR
EA.

INT. CONF. BEAR RES. AND MANAGE. 5:166-173.

FOOD FEED BEH INTERSP COMP

YGBE,IMW , , ,

00604

KENDALL, K.C.

1984A
SUMMARY OF GRIZZLY BEAR RESEARCH IN GLACIER NATIONAL PARK - 1984.

U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 1 PP.

FOOD CENSUS/TREND RECR MGMT

NCDE,MT ,GLNP, ,

00605

KENDALL, K.C.

1984B
GRIZZLY BEAR POPULATION TREND STUDIES, APGAR MOUNTAINS, GLACIER N ATIONAL PARK, 1983 PROGRESS REPORT.

U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 37 PP.

CENSUS/TREND	CENSUS METH	AGE/SEX	FOOD
LITR SIZE	INTERSP COMP	AIRCRAFT IMP	HAB USE
BURN USE/MGT			

NCDE,MT ,GLNP, ,APGR

00606

KENDALL, K.C.

1985
GRIZZLY BEAR POPULATION TREND STUDIES, APGAR MOUNTAINS, GLACIER N ATIONAL PARK.

PROGR. REP. 1984. U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 23 PP.

CENSUS METH	AIRCRAFT IMP	AGE/SEX	INTERSP COMP
CENSUS/TREND	FOOD	HAB USE	

NCDE,MT ,GLNP, ,APGR

00607

KENDALL, K.C.

1986
GRIZZLY AND BLACK BEAR FEEDING ECOLOGY IN GLACIER NATIONAL PARK, MONTANA.

PROGR. REP. U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 42 PP.

FOOD	HAB SAMPL

NCDE,MT ,GLNP, ,

00608

KENDALL, K. C.

IN PRESS
TRENDS IN GRIZZLY/HUMAN INTERACTIONS IN GLACIER NATIONAL PARK, MO NTANA.

INT. CONF. BEAR RES. AND MANAGE. 6.

HUMAN INJ	REACTION	CAMP MGMT	NONMOTOR IMP
AVOID/ATTRAC	MATERNAL		

NCDE,MT ,GLNP, ,

00609

KILGORE, B.M. (CHAIRMAN).

1981
TECHNICAL REVIEW OF THE INTERAGENCY GRIZZLY BEAR STUDY TEAM AND R
ECOMMENDATIONS FOR FUTURE RESEARCH.

PREP. FOR INTERAGENCY GRIZZLY BEAR STUDY TEAM STEERING COMMITTEE.
 PREP. BY THE INTERAGENCY GRIZZLY BEAR STUDY TEAM TECH. REVIEW PA
NEL. 22 PP.

CENSUS METH   DEMOG ANAL

YGBE,IMW , , ,

00610

KINGSLEY, M.C.S.

1979
FITTING THE VON BERTALANFFY GROWTH EQUATICN TO POLAR BEAR AGE-WEI
GHT DATA.

CAN. J. ZOOL. 57:1020-1025.

GROW/DEV   WEIGHT

,GEN , , ,

00611

KINGSLEY, M.C.S., J.A. NAGY AND H.V. REYNOLDS.

IN PRESS
GROWTH IN LENGTH OF NORTHERN BROWN BEARS: SEXUAL DIMORPHISM AND V
ARIATION BETWEEN POPULATIONS.

MANUSCRIPT. 20 PP.

GROW/DEV   WEIGHT   LENGTH

,CAN , , ,

00612

KINGSLEY, M.C.S., J.A. NAGY AND R.H. RUSSELL.

1983
PATTERNS OF WEIGHT GAIN AND LOSS FOR GRIZZLY BEARS IN NORTHERN CA
NADA.

INT. CONF. BEAR RES. AND MANAGE. 5:174-178.

GROW/DEV   WEIGHT

CARC,YK , , ,

00613

KITTAMS, W.H.

1958
SUMMARY OF BEAR INCIDENTS, 1957.

MEMO. TO SUPERINTENDENT, U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL., PARK, WYO. 4 PP.

HUMAN INJ DEPRED CONTROL

YGBE,IMW ,YNP , ,

00614

KLAVER, R.W. AND J.J. CLAAR.

1982
GRIZZLY BEAR DEN SURVEYS, SPRING 1981 AND 1982, FLATHEAD INDIAN R ESERVATION, MONTANA.

U.S.D.I., BUR. INDIAN AFFAIRS, PABLO, MONT. 5 PP.

CENSUS METH

NCDE,MT ,FLIR, ,MISS

00615

KLAVER, R.W., J.J. CLAAR, D.B. ROCKWELL, H.R. MAYS AND C.F. ACEVEDO .

1986
GRIZZLY BEARS, INSECTS, AND PEOPLE: BEAR MANAGEMENT IN THE MCDONA LD PEAK REGION, MONTANA.

PP. 204-211 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-G RIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERVICE. INTERMOU NTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

CLOSURE POP EST CENSUS/TREND FOOD
CENSUS METH NONMOTOR IMP PUBLIC ATT TERR/SPACE
MATERNAL

NCDE,MT ,FLIR, ,MCPK

00616

KLAVER, R.W., L.J. LYON, C.J. MARTINKA, L. METZGAR,J. SWENSON AND D .E.N. TAIT.

1984
NORTHERN CONTINENTAL DIVIDE GRIZZLY BEAR ECOSYSTEM POPULATION SIZ E AND TREND.

SPEC. TASK FORCE REP. PREP. FOR INTERAGENCY GRIZZLY BEAR COMMITTE E. 7 PP.

POP EST CENSUS METH CENSUS/TREND

NCDE,MT , , ,

00617

KLEIN, D.R.

1956
BLACKTAIL DEER STUDIES - SOUTHEAST ALASKA.

FED. AID WILDL. REST. PROJ. W-3-R-10, WORK PLAN E. ALASKA DEP. FISH AND GAME, JUNEAU. 3 PP.

HARV DATA

AKSE,AK , , ,

00618

KLEIN, D.R.

1958
SOUTHEAST ALASKA BROWN BEAR STUDIES.

FED. AID WILDL. REST. PROJ. W-3-R-13, WORK PLAN J, JOB 1.JOB COMPLETION REP., DECEMBER 13, 1958. ALASKA DEP. FISH AND GAME, JUNEAU. 21 PP.

LITR SIZE	CENSUS METH	HARV DATA	AGE/SEX
CENSUS/TREND	LENGTH	GIRTH	SKULL
MISC QUANT			

AKSE,AK , , ,ABC

00619

KLEIN, D.R.

1959
TRACK DIFFERENTIATION FOR CENSUSING BEAR POPULATIONS.

J. WILDL. MANAGE. 23(3):361-363.

CENSUS METH

AKSE,AK , , ,ADIS

00620

KLEIN, D.R.

1974
REACTION OF WILDLIFE TO AIRCRAFT DISTURBANCE.

ALASKA COOP. WILDL. RES. UNIT, UNIV. ALASKA, FAIRBANKS. QUART. REP. 25(1):18-22.

AIRCRAFT IMP

AK-I,AK , , ,

00621

KLEIN, D.R., W. TROYER AND R.A. RAUSCH.

1958
THE STATUS OF THE BROWN BEAR IN ALASKA.

PROC. ALASKA SCI. CONF. 9. 11 PP.

HARV DATA MISC QUANT MGMT GEN CENSUS/TREND POACH/ILLEG LITR SIZE AGE/SEX CENSUS METH

,AK , , ,

00622

KLEIN, W.E.

1982
AN ENLIGHTENING AND SOBERING EXPERIENCE IN CALIFORNIA.

CALIF. DEP. FISH AND GAME, REDDING. 5 PP.

POACH/ILLEG

,CA , , ,

00623

KNIGHT, R.R.

1974
GRIZZLY BEAR STUDY TEAM - FIRST INTERIM REPORT, 1974.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 11 PP.

POP DENS AGE/SEX LITR SIZE HAB USE

YGBE,IMW , , ,

00624

KNIGHT, R.R.

1981A
NOTES ON SOME BEHAVIOR PATTERNS IN RADIO-INSTRUMENTED GRIZZLY BEARS.

DRAFT REP. U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM BOZEMAN, MONT. 10 PP.

REACTION POACH/ILLEG DEPRED CONTROL

YGBE,IMW , , ,

00625

KNIGHT, R.

1981B
INTERAGENCY GRIZZLY BEAR TEAM DATA ENHANCEMENT PROPOSAL: OPERATIO
NAL PLAN.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 11
PP.

RES TECH DEMOG ANAL CENSUS METH CAPTURE
PRES DISTR

YGBE,IMW , , ,

00626

KNIGHT, R.R. (CHAIRMAN).

1984
MONITORING THE YELLOWSTONE GRIZZLY BEAR POPULATION, INTERIM REPOR
T: 1983 RESULTS.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 7 P
P.

CENSUS METH

YGBE,IMW , , ,

00627

KNIGHT, R.R. (CHAIRMAN).

1983
COMMITTEE FINDINGS.

MEMO. TO U.S.D.I., INTERAGENCY GRIZZLY BEAR STEERING COMMITTEE. P
REP. BY INTERAGENCY GRIZZLY BEAR AD HOC COMMITTEE FOR POPULATION
ANALYSIS. 8 PP.

POP EST AGE/SEX CENSUS/TREND BRD AGE
LITR SIZE LITR FREQ

YGBE,IMW , , ,

00628

KNIGHT, R.R., J. BASILE, K. GREER, S. JUDD, L. OLDENBURG AND L. ROO
P.
1975
YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS. ANNUAL REPORT OF THE INT
ERAGENCY STUDY TEAM, 1974.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. MIS
C. REP. NO. 8. 44 PP.

CENSUS METH PRES DISTR AGE/SEX LITR SIZE
POP DENS MORT DATA POP EST HAB USE
PRED
YGBE,IMW , , ,

00629

KNIGHT, R.R., J. BASILE, K. GREER, S. JUDD, L. OLDENBURG AND L. ROOP.
1976
YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS. ANNUAL REPORT OF THE INTERAGENCY STUDY TEAM, 1975.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. MISC. REP. NO. 9. 46 PP.

MOVE	CENSUS METH	PRES DISTR	HAB USE
PRED	DEPRED	AGE/SEX	WEIGHT
HOME RNG			

YGBE,IMW , , ,

C0630

KNIGHT, R.R., J. BASILE, K. GREER, S. JUDD, L. OLDENBURG AND L. ROOP.
1977
YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS. ANNUAL REPORT OF THE INTERAGENCY STUDY TEAM, 1976.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. MISC. REP. NO. 10. 75 PP.

CENSUS METH	AGE/SEX	CENSUS/TREND	PRES DISTR
HAB USE	DEN	FOOD	MOVE
HOME RNG			

YGBE,IMW , , ,

00631

KNIGHT, R.R., J. BASILE, K. GREER, S. JUDD, L. OLDENBURG AND L. ROOP.
1978
YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS. ANNUAL REPORT OF THE INTERAGENCY STUDY TEAM, 1977.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 107 PP.

GEN DATA	MORT DATA	DAY BED	WEIGHT
DEN	ORPHAN	DEPRED	INTERSP COMP
POP BIOL			

YGBE,IMW , , ,

00632

KNIGHT, R.R. AND B. BLANCHARD.

1983
YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS. ANNUAL REPORT OF THE INTERAGENCY STUDY TEAM, 1982.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 45 PP.

AGE/SEX	WEIGHT	HOME RNG	FOOD
CARCASS	MORT RATE	REP RATE	AGE/SEX
DAY BED			

YGBE,IMW , , ,

00633

KNIGHT, R. AND B. BLANCHARD.

1984
POTENTIAL EFFECTS OF THE SKI YELLOWSTONE DEVELOPMENT ON GRIZZLY B
EARS.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 5 P
P.

RECR IMP   PRES DISTR   HOME RNG

YGBE,MT ,GANF, ,SKYL

00634

KNIGHT, R.R. AND B. BLANCHARD.

1985
FIELD TECHNIQUES USED IN THE STUDY OF GRIZZLY BEARS. DRAFT REPORT
.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 26
PP.

CAPTURE   DRUGS   TELEM   MEAS/QUANT
MONIT SYS   HAB SAMPL   SCAT ANAL

YGBE,IMW , , ,

00635

KNIGHT, R.R., B.M. BLANCHARD AND L.L. EBERHARDT.

IN PRESS
POPULATION SINKS AND MORTALITY PATTERNS OF THE YELLOWSTONE GRIZZL
Y.

MANUSCRIPT. 17 PP.

MOVE   MORT MGMT   MORT DATA   HUMAN IMP

YGBE,IMW , , ,

00636

KNIGHT, R.R., B. BLANCHARD AND K. KENDALL.

1981
YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS. ANNUAL REPORT OF THE INT
ERAGENCY STUDY TEAM, 1980.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 55
PP.

GEN DATA   CARCASS   MEAS/QUANT   PELAGE
DRUGS   TELEM   DEMOG ANAL   WEIGHT
GARBAGE
YGBE,IMW , , ,

00637

KNIGHT, R.R., B.M. BLANCHARD AND K.C. KENDALL.

1982
YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS, ANNUAL REPORT OF THE INTERAGENCY STUDY TEAM, 1981.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 70 PP.

BURN USE/MGT	GEN DATA	DEMOG ANAL	CLIMATE
GARBAGE	MORT RATE	CONTROL	CENSUS/TREND
WEIGHT			

YGBE,IMW , , ,

00638

KNIGHT, R.R., B.M. BLANCHARD, K.C. KENDALL AND L.E. OLDENBURG.

1980
YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS. ANNUAL REPORT OF THE INTERAGENCY STUDY TEAM, 1978 AND 1979.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 91 PP.

MOVE	DEMOG ANAL	MORT DATA	FOOD
ACT PATT	DEPRED	TIMB USE	HOME RNG

YGBE,IMW , , ,

00639

KNIGHT, R.R., B. BLANCHARD, AND D. MATTSON.

1984A
INFLUENCES OF THE FISHING BRIDGE AREA ON THE YELLOWSTONE GRIZZLY BEAR POPULATION.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 15 PP.

HAB EFFECT	HAB USE	FOOD	TIMB USE
NUTR ANAL	PRES DISTR	RECR IMP	

YGBE,WY ,YNP , ,FISH

00640

KNIGHT, R.R., B.M. BLANCHARD AND D.J. MATTSON.

1985
YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS. ANNUAL REPORT OF THE INTERAGENCY STUDY TEAM, 1983 AND 1984.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 41 PP.

AGE/SEX	HOME RNG	PRES DISTR	CENSUS/TREND
REP RATE	LITR SIZE	LITR FREQ	MORT DATA
FOOD			

YGBE,IMW , , ,

00641

KNIGHT, R.R., B.M. BLANCHARD AND D. MATTSON.

1986
YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS ANNUAL REPORT OF THE INTERAGENCY STUDY TEAM 1985.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 58 PP.

MORT DATA	MOVE	CENSUS/TREND	REP RATE
GROW/DEV	AGE/SEX	CANNIBAL	FOOD

YGBE,IMW , , ,

00642

KNIGHT, R.R., G. BROWN, J.J. CRAIGHEAD, M. MEAGHER, L. ROOP AND C. SERVHEEN.
1983
AD HOC COMMITTEE TO INVESTIGATE THE NEED AND FEASIBILITY OF THE SUPPLEMENTAL FEEDING OF YELLOWSTONE GRIZZLY BEARS.

FINAL REP. PREP. FOR U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 13 PP.

SUPPL FEED	MORT DATA	CONTROL	WEIGHT
LENGTH		FOOD	

YGBE,IMW , , ,

00643

KNIGHT, R.R. AND L. EBERHARDT.

1984
PROJECTED FUTURE ABUNDANCE OF THE YELLOWSTONE GRIZZLY BEAR.

J. WILDL. MANAGE. 48(4):1434-1438.

GARBAGE	DEMOG ANAL	MORT DATA	CENSUS/TREND

YGBE,IMW , , ,

00644

KNIGHT, R.R. AND L. EBERHARDT.

1985
POPULATION DYNAMICS OF YELLOWSTONE GRIZZLY BEARS.

ECOLOGY 66(2):323-334.

DEMOG ANAL	REP RATE	GARBAGE	MORT RATE
CENSUS/TREND	PCP REG		

YGBE,IMW , , ,

00645

KNIGHT, R.R. AND L.L. EBERHARDT.

IN PRESS
PROSPECTS FOR YELLOWSTONE GRIZZLIES.

INT. CONF. BEAR RES. AND MANAGE. 7.

DEMOG ANAL   CENSUS METH   MORT RATE   CENSUS/TREND

YGBE,IMW ,YNP ,   ,

00646

KNIGHT, R.R. AND S.L. JUDD.

1983
GRIZZLY BEARS THAT KILL LIVESTOCK.

INT. CONF. BEAR RES. AND MANAGE. 5:186-190.

DEPRED   LIVESTK IMP   MOVE   POACH/ILLEG

YGBE,IMW ,   ,   ,

00647

KNIGHT, R.R., D. MATTSON AND B. BLANCHARD.

1984B
MOVEMENTS AND HABITAT USE OF THE YELLOWSTONE GRIZZLY BEAR.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 177
PP.

HAB EFFECT   HAB USE   VEG SUCC   DIVERSITY
FOOD   NUTR ANAL   HOME RNG   MOVE
TIMB USE
YGBE,IMW ,   ,   ,

00648

KNUDSEN, K.L. AND F.W. ALLENDORF.

1985
PRELIMINARY SURVEY OF GENETIC VARIATION IN GRIZZLY BEARS.

UNIV. MONT., MISSOULA. 17 PP.

GENETICS   RES TECH

,US ,   ,   ,

00649

KOBY, F.E.

1963
QUELQUES CONSIDERATIONS SUR LA DESCENDANCE DE L'OURS BRUN. (SOME VIEWS ON THE BROWN BEAR'S PEDIGREE.)

SAUGETIERK MITT. 11(2):58-62.

TAXON/EVOL

,GEN , , ,

00650

KOCH, E.

1941
BIG GAME IN MONTANA FROM EARLY HISTORICAL RECORDS.

J. WILDL. MANAGE. 5(4):357-370.

HIST ACCT HIST DISTR

,MTWY, , ,

00651

KOFORD, C.B.

1968
STATUS OF THE GRIZZLY BEAR IN CHIHUAHUA, MEXICO.

REP. TO A.S. LEOPOLD, UNIV. CALIF., BERKELEY.

HIST DISTR PRES DISTR

MEX , , , ,

00652

KOFORD, C.B.

1969
THE LAST OF THE MEXICAN GRIZZLY BEAR.

INT. UNION CONSERV. NAT. RESOUR. BULL. 21(2):95.

HIST DISTR

,MEX , , ,

00653

KOLZ, A.L., L.J. ROOP AND K.R. GREER.

1978
DEATH OF A RADIO-MARKED GRIZZLY.

J. WILDL. MANAGE. 42(2):462.

TELEM MORT DATA

YGBE,WY ,SHNF, ,

00654

KOWALSKA, Z.

1969
A NOTE ON BEAR HYBRIDS.

INT. ZOO YEARB. 9:89.

REPRO GENETICS

,GEN , , ,

00655

KRAMER, R.J.

1958
ADULT BROWN BEARS CLIMB TREES.

J. MAMMAL. 39(4):588.

MATERNAL BEHAV PATT

AKKA,AK , , ,KARL

00656

KUROZUMI, K., T. HARANO, K. YAMASAKI AND Y. AYAKI.

1973
STUDIES ON BILE ACIDS IN BEAR BILE.

J. BIOCHEM. 74(3):489-495.

PHYS CHEM

,GEN , , ,

00657

KURTEN, B. AND E. ANDERSON.

1974
ASSOCIATION OF URSUS ARCTOS AND ARCTODUS SIMUS (MAMMALIA: URSIDAE
) IN THE LATE PLEISTOCENE OF WYOMING.

BREVIORA 426:1-6.

HIST DISTR

,WY , , ,

00658

LACAVA, J. AND J. HUGHES.

1984
DETERMINING MINIMUM VIABLE POPULATION LEVELS.

WILDL. SOC. BULL. 12:370-376, 1984.

MIN POP

,GEN , , ,

00659

LAUCKHART, J.B. AND E.F. LAYSER.

1975
1974-1975 BIG GAME STATUS REPORT: GRIZZLY BEAR SECTION.

FED. AID WILDL. REST. PROJ. W-79-R6 AND W-84-R2. WASH. DEP. GAME,
OLYMPIA. 8 PP.

HIST DISTR MGMT GEN PCL/ADM MGMT

,WA , , ,

00660

LAYSER, E.F.

1972
NOTES ON GRIZZLY BEAR SIGHTINGS IN NORTHEASTERN WASHINGTON AND AD
JACENT NORTHERN IDAHO.

MURRELET 53(1):8-9.

HIST ACCT

,IDWA, , ,

00661

LAYSER, E.F.

1978
GRIZZLY BEARS IN THE SOUTHERN SELKIRK MOUNTAINS.

NORTHWEST SCI. 52(2):77-91.

HIST DISTR PRES DISTR HARV DATA

SME ,BCIW, , ,

00662

LEACH, R.

1986
GRIZZLY BEAR HABITAT COMPONENT MAPPING IN THE NORTHERN REGION.

PP. 32-35 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

MAP/TYPE

,IDMT,USFS, ,

00663

LECOUNT, A.L.

1982
SCENT-STATION LOCATIONS AFFECT ON ESTIMATING BLACK BEAR ABUNDANCE
.

PROC. WEST. ASSOC. FISH WILDL. AGENCIES 62:408-422.

CENSUS METH

,GEN , , ,

00664

LECOUNT, A.L.

1983A
EVIDENCE OF WILD BLACK BEARS BREEDING WHILE RAISING CUBS.

J. WILDL. MANAGE. 47(1):1983.

REPRO REPRO PHYS LITR SIZE LITR FREQ

,GEN , , ,

00665

LECOUNT, A.L.

1983B
IMMOBILIZATION OF CULVERT-TRAPPED BLACK BEARS WITH ALPHA-CHLORALO
SE.

WILDL. DIGEST ABSTRACT 14. 7 PP.

DRUGS

,GEN , , ,

00666

LECOUNT, A.L. AND K.L. BALDWIN.

IN PRESS
THE BEAR IN THE CLASSROOM.

INT. CONF. BEAR RES. AND MANAGE. 6: .

EDUC

,GEN , , ,

00667

LEE, J., K. RONALD AND N.A. ORITSLAND.

1977
SOME BLOOD VALUES OF WILD POLAR BEARS.

J. WILDL. MANAGE. 41(3):520-526.

HEMAT

,GEN , , ,

00668

LEE, L.C.

1979
TARGET DIAGRAM MODELS: A TECHNIQUE FOR DISPLAYING HABITAT TYPE DI
STRIBUTIONS SAMPLED WITHIN SPECIFIC STUDY AREAS.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 34. 5
1 PP.

HAB SAMPL MAP/TYPE

NCDE,MT , , ,

00669

LEE, L. AND C.J. JONKEL.

1980
THE VEGETATION STRUCTURE AND ECOLOGY OF GRIZZLY BEAR HABITAT IN T
HE PINE AND ANTELOPE BUTTE WETLANDS, MONTANA.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 36. 6
6 PP.

HAB USE HAB RECON LIVESTK IMP ENERGY IMP
HUMAN IMP AGR IMP/MGT MGMT GEN

NCDE,MT , , ,PIBU

00670

LEE, L. AND C. JONKEL

1981
GRIZZLIES AND WETLANDS.

WEST. WILDLANDS 7(4):26-30.

HAB USE LIVESTK IMP FIRE MGMT VEG SUCC
MGMT GEN

NCDE,MT , , ,PIBU

00671

LEE, L. AND T. THIER.

1979
MEXICAN GRIZZLY STUDIES: AN INTERIM REPORT.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA, UNPUBL. REP., 62 PP.

HAB RECON HIST DISTR PRES DISTR HIST ACCT

,MEX , , ,

00672

LEE, P.L. AND J. WEAVER.

1981
BIOLOGICAL EVALUATION MAN/GRIZZLY BEAR CONFLICTS RELATED TO SHEEP
GRAZING IN ESSENTIAL GRIZZLY BEAR HABITAT ON THE TARGHEE NATIONA
L FOREST.

U.S.D.A., FOREST SERV., TARGHEE NATL. FOREST, ST. ANTHONY, IDAHO.
29 PP.

LIVESTK MGMT LIVESTK IMP

YGBE,IDWY,TANF, ,

00673

LENSINK, C.J.

1954
DEFORMED JAW IN AN ALASKAN BROWN BEAR.

J. MAMMAL. 35(3):438-439.

DENT SKULL

AKPN,AK , , ,

00674

LENTFER, J.W.

1965
BROWN BEAR HARVEST STATISTICS IN ALASKA.

PROC. ANNU. CONF. WEST. ASSOC. STATE GAME & FISH COMM. 45:134-139
.

HARV DATA AGE/SEX

,AK , , ,

00675

LENTFER, J.W.

1965
BEAR STUDIES.

FED. AID WILDL. REST. PROJ. W-6-R-6, JOB 6, WORK PLAN F. ANNU. RE
P., VOL. VI., JAN. 1, 1964-DEC 31, 1964. ALASKA DEP. FISH AND GAM
E, JUNEAU. 13 PP.

DEPRED HARV MGMT DETER/REPEL HARV DATA
AGE/SEX MISC QUANT

,AK , , ,

00676

LENTFER, J.W.

1966
BEAR STUDIES.

FED. AID WILDL. REST. PROJ. W-6-R-7 AND W-15-R-1, WORK PLAN F AND
M. ANNU. REP., VOL. VII., JAN. 1, 1965-DEC. 31, 1965. ALASKA DE
P. FISH AND GAME, JUNEAU. 31 PP.

HARV DATA AGE/SEX MISC QUANT POACH/ILLEG
DEPRED DEN PRED LITR SIZE
CENSUS/TREND
,AK , , ,

00677

LENTFER, J.W.

1967
REPORT ON 1966 BEAR STUDIES.

FED. AID WILDL. REST. PROJ. W-15-R-1 AND 2, WORK PLAN M. ANNU. RE P., VOL. VIII, JAN. 1, 1966-DEC. 31, 1966. ALASKA FISH AND GAME D EP., JUNEAU. 54 PP.

HARV DATA　MISC QUANT　DEN　REPRO
LITR SIZE　AGE/SEX　CENSUS/TREND　DEPRED
CONTROL
,AK , , ,

00678

LENTFER, J.W.

1968
REPORT ON 1967 BEAR STUDIES.

FED. AID WILDL. REST. PROJ. W-15-R-2 AND 3, WORK PLAN M. ANNU. RE P., JAN. 1, 1967-DEC. 31, 1967. ALASKA FISH AND GAME DEP., JUNEAU . 31 PP.

AGE DETERM　HARV DATA　AGE/SEX　MISC QUANT
HARV MGMT　DEN　DEPRED　LITR SIZE
CENSUS/TREND
,AK , , ,

00679

LENTFER, J.W. AND L.R. BEIER.

1985
BROWN BEAR WINTER DEN SITE CHARACTERISTICS NORTH ADMIRALTY ISLAND , SOUTHEAST ALASKA, 1982-83.

APPENDIX D. PP. 70-83, IN: J.W. SCHOEN AND L. BEIER. BROWN BEAR H ABITAT PREFERENCES AND BROWN BEAR LOGGING AND MINING RELATIONSHIP S IN SOUTHEAST ALASKA. FED. AID WILDL. REST. PROJ. W-22-3. ALASKA DEPT. FISH AND GAME.

DEN SITE　DEN CHAR

AKSE,AK , , ,ADIS

C0680

LENTFER, J.W., R.J. HENSEL, L.H. MILLER, L.P. GLENN AND V.D. BERNS.

1972
REMARKS ON DENNING HABITS OF ALASKA BROWN BEARS.

INT. CONF. BEAR RES. AND MANAGE. 2:125-132.

DEN SITE　DEN CHAR

AKKA,AK ,KNWR, ,

00681

LENTFER, J.W., L.H. MILLER AND G.N. BOS.

1969
REPORT ON 1968 BEAR STUDIES.

FED. AID WILDL. REST. PROJ. W-15-R-4 AND W-17-1, WORK PLAN M. ANNU. REP., JAN. 1, 1968-DEC. 31, 1968. ALASKA DEP. FISH AND GAME, JUNEAU. 41 PP.

HARV DATA   AGE/SEX   MISC QUANT   REPRO
CAPTURE   DEN   CENSUS/TREND   CONTROL
DEPRED

,AK , , ,

00682

LEONARD, R.D. (ED.).

1983
A REVIEW OF BEAR MANAGEMENT IN PRAIRIE REGION NATIONAL PARKS AND NATIONAL HISTORIC PARKS AND SITES.

PARKS CANADA, DEP. OF ENVIRON., PRAIRIE REGION. 114 PP.

MGMT GEN   MGMT PLAN   EDUC   MONIT SYS
HUMAN INJ   GARB MGMT

,CAN , , ,

00683

LEOPOLD, A.S.

1967
GRIZZLIES OF THE SIERRA DEL NIDO.

PACIFIC DISCOVERY 20(5):30-32.

HIST DISTR

,MEX , , ,

00684

LEOPOLD, A.S.

1969
A BEAR MANAGEMENT POLICY AND PROGRAM FOR YELLOWSTONE NATIONAL PARK.

DIRECTOR'S REP. RESULTING FROM YELLOWSTONE NATL. PARK MEETING, 6-7 SEPT. 1969. PREP. FOR U.S.D.I., NATL. PARK SERV. PREP. BY NAT. SCI. ADVISORY COMM. 8 PP.

GARB MGMT   CAMP MGMT   CONTROL

YGBE,IMW ,YNP , ,

00685

LERESCHE, R.E.

1966
BEHAVIOR AND CALF SURVIVAL IN ALASKA MOOSE.

M.S. THESIS, UNIV. ALASKA, FAIRBANKS. 84 PP.

PRED

AK-I,AK , , ,JIML

00686

LERESCHE, R.E.

1968
SPRING-FALL CALF MORTALITY IN AN ALASKA MOOSE POPULATION.

J. WILDL. MANAGE. 32(4):953-956.

PRED

AK-I,AK , , ,

00687

LIGHT, J.T.

1986
THREATENED AND ENDANGERED SPECIES BIOLOGICAL EVALUATION OPERATING PLAN—HOMESTAKE (JOINT VENTURE), DRAFT ENVIRONMENTAL IMPACT STAT EMENT.

U.S.D.A., FOREST SERVICE, GALLATIN NATL. FOREST, BOZEMAN, MONT. 2 4 PP.

ENERGY IMP ENERGY MGMT

YGBE,MT ,GANF, ,JARD

00688

LINDERMAN, S.

1974
GROUND TRACKING OF ARCTIC GRIZZLY BEARS.

FED. AID WILDL. REST. PROJ. W-17-6, JOB 4.12R. FINAL REP., JULY 1 , 1973-JUNE 30, 1974. ALASKA DEP. FISH AND GAME, JUNEAU. 23 PP.

AIRCRAFT IMP FOOD CARCASS BEHAV PATT
ACT PATT MOVE COURT DAY BED
HOME RNG
ARC ,AK , , ,EBRK

00689

LINDZEY, F. (CHAIRMAN).

1984
A TEST OF TEMPORARY BAITING OF GRIZZLY BEARS.

PREP. FOR INTERAGENCY GRIZZLY BEAR COMMITTEE. PREP. BY INTERAGENC
Y GRIZZLY BEAR TASK FORCE ON TEMPCRARY BAITING. 12 PP.

TEMP BAIT

,GEN , , ,

C0690

LLOYD, K.A.

1979
ASPECTS OF THE ECOLOGY CF BLACK AND GRIZZLY BEARS IN COASTAL BRIT
ISH COLUMBIA.

M.S. THESIS, UNIV. CF B.C., VANCOUVER. 150 PP.

MOVE	HAB USE	DAY BED	HOME RNG
MARK	CENSUS METH	FCOD	NUTR ANAL
FOR STRAT			

BC-C,BC , , ,

00691

LLOYD, K. AND S. FLECK.

1977
SOME ASPECTS OF THE ECOLOGY OF BLACK AND GRIZZLY BEARS IN SOUTHEA
STERN BRITISH COLUMBIA.

B.C. FISH AND WILDL. BRANCH, VICTORIA. 55 PP.

FOOD	HAB USE	DAY BED	ROAD IMP
MOVE	CUT USE	ROAD MGMT	TIMB-METH

CR ,BC , , ,NFLT

00692

LLOYD, K., S. FLECK AND B. SMITH

1977
COASTAL BEAR RESEARCH PROGRESS REPORT.

B.C. FISH AND WILDL. BRANCH, VICTORIA. 22 PP.

FOOD	PRED	HAB USE	DAY BED
MARK	CAPTURE	DRUGS	MOVE

BC-C,BC , , ,AHNU

00693

LONG, C.A.

1965
THE OCCURRENCE OF SUPERNUMERARY BONES IN SKULLS OF NORTH AMERICAN BROWN BEARS, URSUS ARCTOS LINNAEUS.

Z. SAEUGETIERKD. 30(1):30-36.

SKULL TAXON/EVOL

,GEN , , ,

00694

LORTIE, G.M.

1978
THE QUOTA - A NEW MANAGEMENT SYSTEM FOR YUKON GRIZZLY BEAR.

PRES. TO YUKON OUTFITTERS ASSOC., 22 APRIL 1978. PREP. BY YUKON TERRITORIAL GOV. WILDL. BRANCH, WHITEHORSE. 14 PP.

HARV MGMT	OUTFIT MGMT	POP DENS	HARV IMP
BRD AGE	LITR SIZE	LITR FREQ	POP EST

,YK , , ,

00695

LORTIE, G.M. AND J. MCDONALD.

1977
A TWENTY-THREE YEAR ANALYSIS OF GRIZZLY HARVESTS IN THE YUKON TERRITORY.

APPENDIX III. 32 PP. IN: G.M. LORTIE AND J. MCDONALD. GAME HARVEST REPORT AND QUESTIONNAIRE ANALYSIS. YUKON TERRITORIAL GOV. GAME BRANCH, WHITEHORSE.

HARV DATA	CONTROL	POACH/ILLEG	AGE/SEX
HARV IMP	HARV MGMT		

,YK , , ,

00696

LUNDBERG, D.A., R.A. NELSON, H.W. WAHNER AND J.D. JONES.

1976
PROTEIN METABOLISM IN THE BLACK BEAR BEFORE AND DURING HIBERNATION.

MAYO CLIN. PROC. 51:716-722.

HIB PHYS HEMAT

,GEN , , ,

00697

LUQUE, M.H.

1978
FISHING BEHAVIOR OF ALASKA BROWN BEAR, URSUS ARCTOS.

M.S. THESIS, UTAH STATE UNIV., LOGAN. 49 PP.

PRED INTRASP BEH FEED BEH MATERNAL

AK-I,AK , , ,MCNE

00698

LUQUE, M.H. AND A.W. STOKES.

1976
FISHING BEHAVIOUR OF ALASKA BROWN BEAR.

INT. CONF. BEAR RES. AND MANAGE. 3:71-78.

FEED BEH PRED

AKPN,AK ,MCGS, ,MCNE

00699

LYON, L.J.

1984
ROAD EFFECTS AND IMPACTS ON WILDLIFE AND FISHERIES.

PRES. AT FOREST TRANSPORTAION SYMP., 11-13 DEC. 1984, CASPER, WYO. 20 PP.

ROAD IMP TIMB IMP

,GEN , , ,

00700

LYON, L.J. AND J.V. BASILE.

1980
INFLUENCES OF TIMBER HARVESTING AND RESIDUE MANAGEMENT IN BIG GAME.

PROC. ENVIRON. CONSEQUENCES TIMBER HARVESTING IN ROCKY MT. CONIFEROUS FOR. 1980:441-453.

ROAD IMP TIMB IMP TIMB-POST

,GEN , , ,

00701

MACARTHUR, R.H. AND E.O. WILSON.

1967
THE THEORY OF ISLAND BIOGEOGRAPHY.

PRINCETON UNIV. PRESS, PRINCETON, N.J.

MIN POP MGMT GEN

,GEN , , ,

00702

MACE, R.

1982
SOUTH SAN JUAN MOUNTAINS GRIZZLY BEAR SURVEY.

FED. AID WILDL. REST. PROJ. SE-3-4, JOB 1, WORK PLAN 3. JAN. 1-DE
C. 31, 1981. COLO. DIV. WILDL., DENVER. 32 PP.

PRES DISTR HAB RECON

RGNF,CO ,SJNF,SJMT,

00703

MACE, R.D.

1984
IDENTIFICATION AND EVALUATION OF GRIZZLY BEAR HABITAT IN BOB MARS
HALL WILDERNESS AREA, MT.

M.S. THESIS, UNIV. MONT., MISSOULA. 176 PP.

TYPE DESCRIP HAB SAMPL FOOD HAB USE
HAB EFFECT MGMT GEN MAP/TYPE

NCDE,MT ,FLNF,LONF,

00704

MACE, R.D.

1986
ANALYSIS OF GRIZZLY BEAR HABITAT IN THE BOB MARSHALL WILDERNESS,
MONTANA.

PP. 136-149 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-G
RIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTA
IN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

HAB EFFECT TYPE DESCRIP FOOD

NCDE,MT ,FLNF,LONF,BMWA

00705

MACE, R.D., K. AUNE, W. KASWORM AND R. KLAVER.

IN PREP
INCIDENCE OF HUMAN CONFLICTS BY RESEARCH GRIZZLY BEARS.

DRAFT MANUSCRIPT.

HUMAN IMP CONTROL LIVESTK IMP MORT DATA

NCDE,MT , , ,

00706

MACE, R.D. AND G.N. BISSELL.

1986
GRIZZLY BEAR FOOD RESOURCES IN THE FOOD PLAINS AND AVALANCHE CHUT
ES OF THE BOB MARSHALL WILDERNESS, MONTANA.

PP. 78-91 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRI
ZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN
RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

FOOD TYPE DESCRIP HAB EFFECT

NCDE,MT ,FLNF,LONF,BMWA

00707

MACE, R. AND C. JONKEL.

1979A
SEASONAL FOOD HABITS OF THE GRIZZLY BEAR (URSUS ARCTOS HORRIBILIS
ORD.) IN NORTHWESTERN MONTANA.

PP. 28-46 IN: C. JONKEL, ED. ANNUAL REPORT NO. 4. BORDER GRIZZLY
PROJ., UNIV. MONT., MISSOULA.

FOOD

NCDE,MT , , ,

00708

MACE, R. AND C. JONKEL.

1979B
GRIZZLY BEAR RESPONSE TO HABITAT DISTURBANCE.

PP. 48-77 IN: C. JONKEL, ED. ANNUAL REPORT NO. 4. BORDER GRIZZLY
PROJ., UNIV. MONT., MISSOULA.

HOME RNG MEAS/QUANT AGE/SEX MOVE
PRES DISTR RELOC

NCDE,MT , , ,SFLT

00709

MACE, R.D. AND C. JONKEL.

1980A
FOOD HABITS OF THE GRIZZLY BEAR (URSUS ARCTOS HORRIBILIS ORD.) IN MONTANA.

PP. 49-69 IN: C. JONKEL, ED. ANNUAL REPORT NO. 5. BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA.

FOOD

NCDE,MT , , ,

00710

MACE, R.D. AND C. JONKEL.

1980B
THE EFFECTS OF LOGGING ACTIVITY ON GRIZZLY BEAR MOVEMENTS.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 38. 11 PP.

TIMB IMP MOVE PRES DISTR HOME RNG

NCDE,MT , , ,SFLT

00711

MACE, R.D. AND C. JONKEL.

1980C
GRIZZLY BEAR RESPONSE TO HABITAT DISTURBANCE.

PP. 70-98 IN: C. JONKEL, ED. ANNUAL REPORT NO. 5. BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA.

HOME RNG MOVE MEAS/QUANT AGE/SEX
TERR/SPACE FOOD RELOC POP DENS

NCDE,MT , , ,SFLT

00712

MACE, R., J.L. PERRY AND C. JONKEL.

1979
VEGETATION STUDIES OF DISTURBED GRIZZLY HABITAT.

PP. 16-27 IN: C. JONKEL, ED. ANNUAL REPORT NO. 4. BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA.

MEAS/QUANT HAB USE BURN USE/MGT

NCDE,MT , , ,NFLT

00713

MACE, R.D., S. RILEY AND K. AUNE.

IN PREP
RELOCATION OF PROBLEM GRIZZLY BEARS IN NORTHWESTERN MONTANA.

DRAFT MANUSCRIPT. 15 PP.

RELOC

NCDE,MT , , ,

00714

MACE, R., C. SERVHEEN AND G. DAY.

1978
GRIZZLY RELOCATIONS IN THE YAAK RIVER DRAINAGE.

PP. 215-227 IN: C. JONKEL, ED. ANNUAL REPORT NO. 3. BORDER GRIZZL
Y PROJ., UNIV. MONT., MISSOULA.

RELOC MEAS/QUANT MOVE HAB USE
INT/REINT

CYE ,BIM , , ,

00715

MACEY, A.

1979
THE STATUS OF THE GRIZZLY BEAR (URSUS ARCTOS HORRIBILIS) IN CANAD
A.

NATL. MUS. OF NAT. SCI., OTTAWA, CANADA. 54 PP.

GEN BIOL DISTR POP BIOL POP EST
POP DENS

,CAN , , ,

00716

MACLENTZ, W., R.L. MARCHINTON AND R.E. SMITH.

1983
THERMODYNAMIC ANALYSIS OF NORTHEASTERN GEORGIA BLACK BEAR DENS.

J. WILDL. MANAGE. 47(2):545-549.

DEN CHAR TEMP

,GEN , , ,

00717

MACPHERSON, A.H.

1965
THE BARREN-GROUND GRIZZLY.

CAN. AUDUBON 27(1):2-8.

LEGAL HIST DISTR MGMT GEN HARV MGMT

,NWT , , ,

00718

MACPHERSON, A.H.

1966
GRIZZLY BEAR IN DANGER.

ORYX 8(5):295-301.

HIST DISTR HARV MGMT LEGAL MGMT GEN

,NWT , , ,

00719

MADEL, M.J.

1982
GRIZZLY BEAR HABITAT DELINEATION AND RECONNAISSANCE IN THE CABINE
T MOUNTAINS: A PROCEDURAL DESCRIPTION.

SECTION II. 37 PP. IN: CUMULATIVE EFFECTS ANALYSIS PROCESS. GRIZZ
LY HABITAT COMPONENT MAPPING. U.S.D.A., FOREST SERV., KOOTENAI NA
TL. FOREST, MONT.

MAP/TYPE

CYE ,IDMT,KONF, ,CAB

00720

MADEL, M.

1983
BIOLOGICAL ASSESSMENT FOR THE PROPOSED GREAT NORTHERN MOUNTAIN SK
I DEVELOPMENT.

U.S.D.A. FOREST SERV., KOOTENAI NATL. FOREST, LIBBY, MONT. 62 PP.

CUM EFF RECR IMP RECR MGMT

CYE ,MT ,KONF, ,

00721

MAGOUN, J.

1976
SUMMER SCAVENGING ACTIVITY IN NORTHEASTERN ALASKA.

M.S. THESIS, UNIV. ALASKA, FAIRBANKS. 168 PP.

CARCASS FEED BEH INTERSP COMP ACT PATT
AGON

ARC ,AK , , ,EBRK

00722

MAGUIRE, L.A.

1985
AN ANALYSIS OF AUGMENTATION STRATEGIES FOR GRIZZLY POPULATIONS: T
HE CABINET-YAAK ECOSYSTEM AS AN EXAMPLE. (DRAFT).

PREP. FOR U.S.D.A., FOREST SERV. CONTRACT 40-3187-4-1748.

POP AUG RELOC

CYE ,IDMT, , ,

00723

MAJOR, M., M.K. JOHNSON, W.S. DAVIS AND T.F. KELLOGG.

1980
IDENTIFYING SCATS BY RECOVERY OF BILE ACIDS.

J. WILDL. MANAGE. 44(1):290-293.

SCAT ANAL

,GEN , , ,

00724

MANLOVE, M.N., R. BACCUS, M.R. PELTON, M.H. SMITH AND D. GARBER.

1980
BIOCHEMICAL VARIATION IN THE BLACK BEAR.

INT. CONF. BEAR RES. AND MANAGE. 4:37-41.

GENETICS

,GEN , , ,

00725

MARCH, K.S.

1980
DEERS, BEARS, AND BLOOD: A NOTE ON NONHUMAN ANIMAL REPSONSE TO ME
NSTRUAL ODOR.

AM. ANTHROP. 82(1):125-127.

AVOID/ATTRAC

,GEN , , ,

00726

MARSH, J.S.

1972
BEARS AND MAN IN GLACIER NATIONAL PARK, BRITISH COLUMBIA, 1880-19
80.

INT. CONF. BEAR RES. AND MANAGE. 2:289-296.

HIST ACCT HIST DISTR PUBLIC ATT

CR ,BC ,CGNP, ,

00727

MARSH, J.

1970
BEARS AND THE PUBLIC IN OUR NATIONAL PARKS - A SURVEY OF ATTITUDE
S TO BEARS AND THEIR MANAGEMENT.

CAN. AUDUBON 32(2):43-45.

PUBLIC ATT EDUC

CR ,ATBC,BANP,CGNP,

00728

MARSHALL, P.B.

1955
GRIZZLY BEAR SURVEY.

FED. AID WILDL. REST. PROJ. W-60-R-2, JOB I-D, WORK PLAN I. MONT.
FISH AND GAME DEP., HELENA. 20 PP.

CENSUS/TREND HARV DATA AGE/SEX HIST DISTR

NCDE,MT , , ,

C0729

MARTIN, N.

1966
BIG GAME SURVEYS AND INVESTIGATIONS - ANTELOPE, BIGHORN SHEEP, MOUNTAIN GOATS AND BEAR.

FED. AID WILDL. REST. PROJ. W-74-R-10, JOB A-1. JOB COMPLETION REP., JULY 1, 1964-JUNE 30, 1965. MONT. FISH AND GAME DEP., HELENA. 12 PP.

HARV DATA

NCDE,MT , , ,

00730

MARTIN, N.

1967
BIG GAME SURVEYS AND INVESTIGATIONS - ANTELOPE, BIGHORN SHEEP, MOUNTAIN GOATS AND BEAR.

FED. AID WILDL. REST. PROJ. W-74-R-12, JOB A-1. JOB COMPLETION REP., JULY 1, 1965-JUNE 30, 1966. MONT. FISH AND GAME DEP., HELENA. 12 PP.

HARV DATA

NCDE,MT , , ,

00731

MARTIN, N.

1968
BIG GAME SURVEYS AND INVESTIGATIONS - ANTELOPE, BIGHORN SHEEP, MOUNTAIN GOATS AND BEAR.

FED. AID WILDL. REST. PROJ. W-74-R-12, JOB A-1. JOB COMPLETION REP., JULY 1, 1966-JUNE 30, 1967. MONT. FISH AND GAME DEP., HELENA. 15 PP.

HARV DATA

NCDE,MT , , ,

00732

MARTIN, P.

1978
VACCINIUM PRODUCTIVITY AND TAXONOMY STUDY.

PP. 135-159 IN: C. JONKEL, ED. ANNUAL REPORT NO. 3. BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA.

FOOD HAB SAMPL VEG SUCC

NCDE,MT , , ,

00733

MARTIN, S.

1983
U.S. BORAXO AND CHEMICAL CORPORATION GRIZZLY BEAR STUDY.

PREP. FOR ECON INC., HELENA, MONT. PROJECT 323-85-A.

HAB RECON PRES DISTR

CYE ,MT ,KONF, ,

00734

MARTIN, P.

1983
FACTORS INFLUENCING GLOBE HUCKLEBERRY FRUIT PRODUCTION IN NORTHWESTERN MONTANA.

INT. CONF. BEAR RES. AND MANAGE. 5:159-165.

VEG SUCC FIRE MGMT TIMB MGMT TIMB-POST
FOOD

NCDE,MT ,FLNF, ,

00735

MARTINKA, C.J.

1968
TERRESTRIAL ECOLOGY STUDIES, GLACIER NATIONAL PARK.

PROG. REP. 1967-68, U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 58 PP.

PRES DISTR POP DENS POP EST AGE/SEX
HAB USE HUMAN INJ INTRASP BEH ORPHAN
NONMOT MGMT
NCDE,MT ,GLNP, ,

00736

MARTINKA, C.J.

1969
GRIZZLY ECOLOGY STUDIES, GLACIER NATIONAL PARK.

PROG. REP. 1968, U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 43 PP.

GEN DATA INTRASP BEH HUMAN INJ MORT DATA
POP BIOL NONMOT MGMT POP DENS POP EST
DEN
NCDE,MT ,GLNP, ,

00737

MARTINKA, C.J.

1970
GRIZZLY ECOLOGY STUDIES, GLACIER NATIONAL PARK.

PROG. REP. 1969, U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 43 PP

GEN DATA	POP BIOL	HUMAN INJ	CONTROL
NONMOT MGMT	GARBAGE	INTRASP BEH	MORT DATA
POP DENS			

NCDE,MT ,GLNP, ,

00738

MARTINKA, C.J.

1971
STATUS AND MANAGEMENT OF GRIZZLY BEARS IN GLACIER NATIONAL PARK, MONTANA.

TRANS. NORTH AM. WILDL. AND NAT. RESOUR. CONF. 36:312-322.

POP DENS	POP EST	HUMAN INJ	DEPRED
CONTROL	GARBAGE	MGMT GEN	

NCDE,MT ,GLNP, ,

00739

MARTINKA, C.J.

1972
HABITAT RELATIONSHIPS OF GRIZZLY BEARS IN GLACIER NATIONAL PARK.

PROG. REP. 1972, U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 19 PP.

HAB USE	FOOD	CARCASS	PRED
BURN USE/MGT	INTERSP COMP		

NCDE,MT ,GLNP, ,

00740

MARTINKA, C.J.

1973A
INTERIM REPORT ON GRIZZLY BEAR RESEARCH.

MEMO. TO SUPERINTENDENT, U.S.D.I., NATL. PARK SERV., GLACIER NATL . PARK, MONT. 12 PP.

CENSUS/TREND	POP EST	LITR SIZE	AGE/SEX
POP DENS	MORT DATA	HUMAN INJ	CONTROL

NCDE,MT ,GLNP, ,

00741

MARTINKA, C.J.

1974A
POPULATION CHARACTERISTICS OF GRIZZLY BEARS IN GLACIER NATICNAL P
ARK, MONTANA.

J. MAMMAL. 55(1):21-29.

POP EST	POP DENS	AGE/SEX	LITR SIZE
WEAN	INTRASP BEH	MORT DATA	CONTROL

NCDE,MT ,GLNP, ,

00742

MARTINKA, C.J.

1974B
PRESERVING THE NATURAL STATUS OF GRIZZLIES IN GLACIER NATIONAL PA
RK.

WILDL. SOC. BULL. 2(1):13-17.

HUMAN INJ	DEPRED	NONMOT MGMT	CONTROL

NCDE,MT ,GLNP, ,

00743

MARTINKA, C.J.

1974C
GRIZZLY BEAR POPULATION STUDIES IN GLACIER NATIONAL PARK, MONTANA
.

PP. 195-206 IN: RESEARCH IN THE PARKS. TRANS. OF THE NATL. PARK C
ENTENNIAL SYMP. U.S.D.I., NATL. PARK SERV. SYMP. SER. NO. 1.

POP EST	POP DENS	AGE/SEX	LITR SIZE
WEAN	INTRASP BEH	MORT DATA	CONTROL

NCDE,MT ,GLNP, ,

00744

MARTINKA, C.J.

1976
ECOLOGICAL ROLE AND MANAGEMENT OF GRIZZLY BEARS IN GLACIER NATION
AL PARK.

INT. CONF. BEAR RES. AND MANAGE. 3:147-156.

DISTR	POP EST	POP DENS	TERR/SPACE
HUMAN INJ	CONTROL	RELOC	

NCDE,MT ,GLNP, ,

00745

MARTINKA, C.J.

1982A
A SUMMARY OF GRIZZLY BEAR RELOCATIONS IN GLACIER NATIONAL PARK.

U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 1 PP.

RELOC

NCDE,MT ,GLNP, ,

00746

MARTINKA, C.J.

1982B
EFFECTS OF CONTERMINOUS LAND USE ON GRIZZLY BEARS IN GLACIER NATI
CNAL PARK.

PRES. AT AM. ASSOC. FOR ADVANCEMENT OF SCI. SYMPOSIUM ON EXTERNAL
THREATS TO ECOSYSTEMS OF NATL. PARKS, 3-8 JANUARY 1982, WASHINGT
ON, D.C.

ROAD IMP CENSUS/TREND MOVE
CONTROL MORT DATA

NCDE,MT ,GLNP, ,

00747

MARTINKA, C.J.

1982C
RATIONALE AND OPTIONS FOR MANAGEMENT IN GRIZZLY BEAR SANCTUARIES.

TRANS. NORTH AM. WILDL. AND NAT. RESOUR. CONF. 47:470-475.

HUMAN INJ CONTROL NONMOT MGMT

NCDE,MT ,GLNP, ,

00748

MARTINKA, C.J. AND K.C. KENDALL.

1986
GRIZZLY BEAR HABITAT RESEARCH IN GLACIER NATIONAL PARK, MONTANA.

PP. 19-23 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRI
ZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN
RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

RECR MGMT FOOD

NCDE,MT ,GLNP, ,

00749

MATEJKO, G. AND B. FRANKLIN.

1983
SUMMARY OF THE GRIZZLY BEAR NO. 38/SHEEP INCIDENT, AUGUST 23 TO S
EPTEMBER 9, 1983, TWO TOP S & G ALLOTMENT.

U.S.D.A., FOREST SERV., TARGHEE NATL. FOREST, ST. ANTHONY, IDAHO.
 8 PP.

DEPRED DETER/REPEL LIVESTK MGMT LIVESTK IMP

YGBE,ID ,TANF, ,ISLP

00750

MATTSON, D.J.

1983
PRELIMINARY ASSESSMENT OF SHORT-ROTATION (70-120 YEARS) TIMBER MA
NAGEMENT EFFECTS ON FOREST COVER TYPE COMPOSITION AND GRIZZLY BEA
R.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 9 P
P.

FOOD HAB USE TIMB USE VEG SUCC
TIMB-HAB COVER TYPE DESCRIP HAB EFFECT

YGBE,IMW , , ,

00751

MATTSON, D.J.

1984
CLASSIFICATION AND ENVIRONMENTAL RELATIONSHIPS OF WETLAND VEGETAT
ION IN CENTRAL YELLOWSTONE NATIONAL PARK, WYOMING.

M.S. THESIS, UNIV. IDAHC, MOSCOW. 409 PP.

HAB USE FOOD FEED BEH MAP/TYPE

YGBE,WY ,YNP , ,

00752

MATTSON, D.J., B.M. BLANCHARD AND R.R. KNIGHT.

IN PRESSA
FOOD HABITS OF THE YELLCWSTONE GRIZZLY BEAR.

INT. CONF. BEAR RES. AND MANAGE. 7.

FOOD FOR STRAT PRED CARCASS
NUTR ANAL

YGBE,WY ,YNP , ,

00753

MATTSON, D.J. AND D.G. DESPAIN.

1985
GRIZZLY BEAR HABITAT COMPONENT MAPPING HANDBOOK FOR THE YELLOWSTO
NE ECOSYSTEM.

U.S.D.A., FOREST SERV., YELLOWSTONE NATL. PARK, WYO. 37 PP.

MAP/TYPE

YGBE,IMW , , ,

00754

MATTSON, D.J., R.R. KNIGHT AND B.M. BLANCHARD.

1986
DERIVATION OF HABITAT COMPONENT VALUES FOR THE YELLOWSTONE GRIZZL
Y BEAR

PP. 222-229 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-G
RIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTA
IN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

HAB EFFECT

YGBE,IMW , , ,

00755

MATTSON, D.J., R.R. KNIGHT AND B.M. BLANCHARD.

IN PRESSB
THE EFFECTS OF DEVELOPMENTS AND PRIMARY ROADS ON GRIZZLY BEARS IN
YELLOWSTONE NATIONAL PARK, WYOMING.

INT. CONF. BEAR RES. AND MANAGE. 7. (PAPER PRESENTED)

ROAD IMP MOTOR IMP INTRASP BEH FOR STRAT
MORT DATA

YGBE,IMW ,YNP , ,

00756

MATTSON, D.J. AND D.P. REINHART.

1986
GRIZZLY BEAR, RED SQUIRRELS, AND WHITEBARK PINE: SECOND YEAR PROG
RESS REPORT.

PP. 39-51 IN: R.R. KNIGHT, B.M. BLANCHARD AND D. MATTSON, YELLOWS
TONE GRIZZLY BEAR INVESTIGATIONS ANNUAL REPORT OF THE INTERAGENCY
STUDY TEAM, 1985. U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM
, BOZEMAN, MONT.

FOOD TIMB USE TIMB MGMT

YGBE,IMW , , ,

00757

MAW, R.

1986
VISITOR KNOWLEDGE AND PERCEPTION OF BEARS AND BEAR MANAGEMENT PRA
CTICES, WATERTON LAKE NATIONAL PARK, CANADA.

PH.D. DISS., UNIV. ALBERTA, EDMONTCN. 173 PP.

PUBLIC ATT RECR MGMT ECUC

CR ,AT ,WANP, ,

00758

MAYNARD, J.E. AND I.G. KAGAN.

1964
INTRADERMAL TEST IN THE DETECTION OF TRICHINCSIS. FURTHER OBSERVA
TIONS ON TWO OUTBREAKS DUE TO BEAR MEAT IN ALASKA.

NEW ENGLAND J. MED. 270(1):1-6.

PARAS/DIS

AK-I,AK , , ,

00759

MAYNARD, J.E. AND F.P. PAULS.

1962
TRICHINOSIS IN ALASKA. A REVIEW AND REPORT OF TWO OUTBREAKS DUE T
O BEAR MEAT WITH OBSERVATIONS CN SERODIAGNOSIS ANC SKIN TESTING.

AM. J. HYG. 76(3):252-261.

PARAS/DIS

AK-I,AK , , ,

00760

MCALLISTER, F.D.

1977
GRIZZLY BEARS AND PUBLIC ATTITUDES.

B.S. THESIS, UNIV. OF B.C., VANCOUVER. 25 PP.

PUBLIC ATT

,BC , , ,

00761

MCARTHUR, K.L.

1978
USE OF BEAR OBSERVATIONS TO QUANTIFY AND PREDICT BEAR HAZARDS, GL
ACIER NATIONAL PARK.

PROG. REP., U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT.
12 PP.

MONIT SYS   REACTION   RECR MGMT

NCDE,MT ,GLNP, ,

00762

MCARTHUR, K.L.

1979A
THE BEAR HAZARD INDEX SYSTEM GLACIER NATIONAL PARK.

PROG. REP., U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT.
8 PP.

MONIT SYS   RECR MGMT   REACTION

NCDE,MT ,GLNP, ,

00763

MCARTHUR, K.L.

1979B
METHODS IN THE STUDY OF GRIZZLY BEAR BEHAVIOR IN RELATION TO PEOP
LE IN GLACIER NATIONAL PARK.

PRES. AT SECOND CONF. SCI. RES. IN NATL. PARKS, 26-30 NOVEMBER 19
79, SAN FRANCISCO. 14 PP.

HUMAN INJ   DEPRED   REACTION   RECR MGMT
MONIT SYS

NCDE,MT ,GLNP, ,

00764

MCARTHUR, K.L.

1979C
THE BEHAVIOR OF GRIZZLY BEARS IN RELATION TO PEOPLE IN GLACIER NA
TIONAL PARK - A LITERATURE REVIEW.

PROG. REP., U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT.
70 PP.

INTRASP BEH   HUMAN INJ   AVER COND   GEN BIOL

,GEN , , ,

00765

MCARTHY, T.

1986
SUMMARY OF 1984 BROWN BEAR FOOD HABITS.

PP. 44-45 IN: J.W. SCHOEN AND L. BEIER, BROWN BEAR HABITAT PREFER ENCES AND BROWN BEAR LOGGING AND MINING RELATIONSHIPS IN SOUTHEAS T ALASKA. FED. AID WILDL. REST. PROJ. ALASKA DEP. FISH AND GAME, JUNEAU.

FOOD PRED

AKSE,AK , , ,ADIS

00766

MCCOURT, K.H., J.D. FEIST, D. DOLL AND J.J. RUSSELL.

1974
A STUDY OF THE REACTIONS OF CARIBOU, MOOSE AND GRIZZLY BEAR TO AI RCRAFT DISTURBANCE.

ARCTIC GAS BIOL. REP. SER. 5:181-215.

AIRCRAFT IMP

ARC ,AK , , ,EBRK

00767

MCCRACKEN, H.

1955
THE BEAST THAT WALKS LIKE A MAN.

HANOVER HOUSE, GARDEN CITY, N.Y. 319 PP.

HIST ACCT

,GEN , , ,

00768

MCCRORY, W.

1984
GRIZZLY BEAR HABITAT CAPABILITY AND USE IN RELATION TO RECREATION AL FACILITIES IN VALHOLLA PROVINCIAL PARK.

PREP. FOR VALHOLLA PROVINCIAL PARK. 158 PP.

HAB RECON HAB USE FOOD RECR MGMT

CR ,BC ,VAPP, ,

00769

MCCRORY, W.

1985
GRIZZLY BEAR HABITAT AND OUTDOOR RECREATION IN KOKANEE GLACIER PR
OVINCIAL PARK, CONFLICTS AND RECOMMENDATIONS.

SUBMITTED TO B.C. PARKS AND OUTDOOR RECREATION DIV., KAMLOOPS. 11
8 PP.

HAB RECON   HAB USE   NONMOT MGMT   FOOD
GARBAGE   GARB MGMT   CAMP MGMT

CR ,AT ,KGPP, ,

00770

MCCRORY, W. AND S. HERRERO.

1981
AN EVALUATION OF GRIZZLY BEAR AUTUMN FEEDING SIGN AND HABITAT IN
THE UPPER HIGHWOOD RIVER VALLEY, ALBERTA.

PREP. FOR ALBERTA FISH AND WILDL. DIV., CALGARY. 178 PP.

HAB RECON   FOOD   HAB USE   PRED

CR ,AT , , ,KANA

00771

MCCRORY, W. AND S. HERRERO.

1982
A REVIEW OF THE HISTORICAL STATUS OF THE GRIZZLY BEAR IN KANANASK
IS COUNTRY, ALBERTA.

PREP. FOR ALBERTA FISH AND WILDL. DIV., CALGARY. PREP. BY BIOS EN
VIRON. RES. AND PLANNING ASSOC. LTD., CALGARY. 123 PP.

HIST ACCT   HIST DISTR   LIVESTK IMP   AGR IMP/MGT
CONTROL   HARV IMP   HARV DATA

CR ,AT , , ,KANA

00772

MCCRORY, W. AND S. HERRERO.

1983A
THE CAPABILITY AND USE OF GRIZZLY BEAR HABITATS IN THE KANANASKIS
AND SPRAY LAKES VALLEYS AND AREAS FROM CANMORE TO MT. ALLAN.

PREP. FOR ALBERTA FISH AND WILDL. DIV., CALGARY. PREP. BY BIOS EN
VIRON. RES. AND PLANNING ASSOC. LTD., CALGARY. 249 PP.

HAB RECON   HAB USE   FOOD   MOTOR MGMT
NONMOT MGMT

CR ,AT , , ,KANA

00773

MCCRORY, W. AND S. HERRERO.

1983B
THE CAPABILITY AND USE OF GRIZZLY BEAR HABITATS IN THE HEADWATERS OF THE LITTLE ELBOW, ELBOW, SHEEP, AND HIGHWOOD VALLEYS, 1982.

PREP. FOR ALBERTA FISH AND WILDL. DIV., CALGARY. PREP. BY BIOS ENVIRON. RES. AND PLANNING ASSOC. LTD., CALGARY. 173 PP.

HAB RECON HAB USE FOOD RECR IMP
RECR MGMT

CR ,AT , , ,

00774

MCCRORY, W., S. HERRERO AND T. TOTH.

1982
GRIZZLY BEAR HABITAT POTENTIAL AND FEEDING AREAS IN THE KANANASKIS AND SPRAY LAKES VALLEYS.

PREP. FOR ALBERTA FISH AND WILDL. DIV., CALGARY. PREP. BY BIOS ENVIRON. RES. AND PLANNING ASSOC. LTD., CALGARY. 372 PP.

HAB RECON HAB USE FOOD NONMOT MGMT
MOTOR MGMT MGMT GEN

CR ,AT , , ,KANA

00775

MCCRORY, W., S. HERRERO AND P. WHITFIELD.

1986
USING GRIZZLY BEAR HABITAT INFORMATION TO REDUCE HUMAN-GRIZZLY BEAR CONFLICTS IN KOKANEE GLACIER AND VALHALLA PROVINCIAL PARKS, BC.

PP. 24-30 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

HAB USE HAB EFFECT RECR IMP RECR MGMT
HAB SAMPL

BC-I,BC ,KGNP,VAPP,

00776

MCCULLOUGH, D.R.

1981
POPULATION DYNAMICS OF THE YELLOWSTONE GRIZZLY BEAR.

PP. 173-196 IN: C.W. FOWLER, ED. DYNAMICS OF LARGE MAMMAL POPULATIONS. JOHN WILEY AND SONS.

POP EST POP REG MORT RATE AGE/SEX
DEMOG ANAL MGMT GEN HARV IMP

YGBE,IMW , , ,

00777

MCCULLOUGH, D.R.

1982
BEHAVIOR, BEARS AND HUMANS.

WILDL. SOC. BULL. 10(1):27-33.

AVER COND HUMAN INJ DETER/REPEL

,GEN , , ,

00778

MCCULLOUGH, D.R.

IN PRESS
INTERPRETATION OF THE CRAIGHEADS' DATA ON YELLOWSTONE GRIZZLY BEAR POPULATIONS, AND ITS RELEVANCE TO CURRENT RESEARCH AND MANAGEMENT.

INT. CONF. BEAR RES. AND MANAGE. 6.

DEMOG ANAL POP EST POP REG AGE/SEX
MGMT GEN

YGBE,IMW , , ,

00779

MCKNIGHT, D.E. (ED.).

1970
SURVEY-INVENTORY ACTIVITIES. PART II. CARIBOU, BROWN BEAR, SHEEP, FURBEARERS, MARINE MAMMALS, BISON, GOAT, WOLF, AND BLACK BEAR.

FED. AID WILDL. REST. PROJ. W-17-2, JOB NOS. 3, 4, 6, 7, 8, 9, 12, 14 AND 17. ANNU. REP., VOL. I. ALASKA DEP. FISH AND GAME, JUNEAU. 94 PP.

HARV DATA HARV MGMT MISC QUANT SKULL
AGE/SEX

,AK , , ,

00780

MCKNIGHT, D.E. (ED.).

1971
SURVEY-INVENTORY ACITIVITES. PART II - CARIBOU, BROWN-GRIZZLY BEAR, SHEEP, FURBEARERS, MARINE MAMMALS, BISON, GOAT, WOLF, WOLVERINE AND BLACK BEAR.

FED. AID WILDL. REST. PROJ. W-17-R-3, JOB NOS. 3, 4, 6, 7, 8, 9, 12, 14, 15 AND 17. ANNU. REP., VOL. II. ALASKA DEP. FISH AND GAME, JUNEAU. 145 PP.

HARV DATA MEAS/QUANT SKULL AGE/SEX

,AK , , ,

00781

MCKNIGHT, D.E. (ED.).

1973
SURVEY-INVENTORY ACTIVITIES. PART II - CARIBOU, BROWN-GRIZZLY BEA
R, SHEEP, MUSKOXEN, MARINE MAMMALS, BISON, GOAT AND BLACK BEAR.

FED. AID WILDL. REST. PROJ. W-17-R-4, JOB NOS. 3, 4, 6, 7, 8, 9,
12, 14, 15 AND 17. ANNU. REP., VOL. III. ALASKA DEP. FISH AND GAM
E, JUNEAU. 174 PP.

HARV DATA MORT DATA AGE/SEX MEAS/QUANT
SKULL

,AK , , ,

00782

MCKNIGHT, D.E. (ED.).

1974A
SURVEY-INVENTORY ACTIVITIES. PART I. DEER, BROWN-GRIZZLY BEAR, SH
EEP, BISON, ELK AND MUSKOXEN.

FED. AID WILDL. REST. PROJ. W-17-5, JOB NOS. 2, 4, 6, 9, 13, 16 A
ND 22. ANNU. REP., VOL. IV. ALASKA DEP. FISH AND GAME, JUNEAU. 15
2 PP.

HARV DATA HARV MGMT MISC QUANT SKULL
AGE/SEX

,AK , , ,

00783

MCKNIGHT, D.E. (ED.).

1974B
SURVEY-INVENTORY ACTIVITIES. PART I. DEER, BROWN-GRIZZLY BEAR, SH
EEP, BISON, ELK AND MUSKOXEN.

FED. AID WILDL. REST. PROJ. W-17-6, JOB NOS. 2, 4, 6, 9, 13, 16 A
ND 22. ANNU. REP., VOL. V. ALASKA DEP. FISH AND GAME, JUNEAU. 169
PP.

HARV DATA HARV MGMT MISC QUANT SKULL
AGE/SEX

,AK , , ,

00784

MCKNIGHT, D.E. (ED.).

1976
SURVEY-INVENTORY ACTIVITIES. PART III. CARIBOU, BROWN BEAR, POLAR
BEAR AND BLACK BEAR.

FED. AID WILDL. REST. PROJ. W-17-7, JOB NOS. 3, 4, 5, 17 AND 22.
ANNU. REP., VOL. VI. ALASKA DEP. FISH AND GAME, JUNEAU. 157 PP.

HARV DATA HARV MGMT AGE/SEX SKULL

,AK , , ,

00785

MCLELLAN, B.N.

1981A
A METHOD FOR ESTIMATING THE WEIGHT OF GRIZZLY BEARS FROM BODY MEA
SUREMENTS.

CAN. BORDER GRIZZLY PROJ., CRANBROOK, B.C. 8PP.

WEIGHT LENGTH GIRTH

,GEN , , ,

00786

MCLELLAN, B.N.

1981B
AKAMINA-KISHINENA GRIZZLY PROJECT, PROGRESS REPORT, 1980 (YEAR TW
O).

B.C. FISH AND WILDL. BRANCH, VICTORIA. 88 PP.

GEN DATA POP BIOL MEAS/QUANT REACTION
ROAD IMP BURN USE/MGT
DEN
CR ,BC , , ,AKKI

00787

MCLELLAN, B.N.

1983
ASPECTS OF THE BEHAVIOUR OF GRIZZLY BEARS IN RESPONSE TO HYDROCAR
BON EXPLORATION AND THE PRESENCE OF HUMANS.

DRAFT REP., CAN. BORDER GRIZZLY PROJ., B.C. WILDL. BRANCH, CRANBR
OOK. 50 PP.

ENERGY IMP ROAD IMP AIRCRAFT IMP REACTION
COVER

NCDE,BCMT, , ,NFLT

00788

MCLELLAN, B.N.

1984
POPULATION PARAMETERS OF THE FLATHEAD GRIZZLIES.

B.C. FISH AND WILDL. BRANCH, VICTORIA. 28 PP.

BRD AGE LITR FREQ LITR SIZE MORT RATE
POP DENS AGE/SEX DEMOG ANAL

CR ,BC , , ,NFLT

00789

MCLELLAN, B.N.

1986
USE-AVAILABILITY ANALYSIS AND TIMBER SELECTION BY GRIZZLY BEARS.

PP. 163-166 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-G
RIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTA
IN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

HAB SAMPL　　TIMB USE

CR ,BC , , ,NFLT

00790

MCLELLAN, B.N. AND C. JONKEL.

1980
AKAMINA-KISHINENA GRIZZLY PROJECT.

PP. 9-48 IN: C. JONKEL, ED. ANNUAL REPORT NO. 5. BORDER GRIZZLY P
ROJ., UNIV. MONT., MISSOULA.

AGE/SEX　　MEAS/QUANT　　HOME RNG　　DEN
MOVE　　CUT USE　　HAB USE

NCDE,ABM , , ,AKKI

00791

MCLELLAN, B.N. AND R.D. MACE.

1985
BEHAVIOR OF GRIZZLY BEARS IN RESPONSE TO ROADS, SEISMIC ACTIVITY,
AND PEOPLE.

PRELIMINARY REP., CAN. BORDER GRIZZLY PROJ., CRANBROOK, B.C. 53 P
P.

ROAD IMP　　ENERGY IMP　　AIRCRAFT IMP　　NONMOTOR IMP
MOTOR IMP　　COVER　　REACTION

NCDE,BCMT, , ,NFLT

00792

MCMURRAY, N., T. WERNER, T. THIER AND C. JONKEL.

1978
GRIZZLY BEAR RESPONSE TO HABITAT DISTURBANCE.

PP. 231-247 IN: C. JONKEL, ED. ANNUAL REPORT NO. 3. BORDER GRIZZL
Y PROJ., UNIV. MONT., MISSOULA.

DRUGS　　MEAS/QUANT　　AGE/SEX

NCDE,MT , , ,SFLT

00793

MCNAMEE, T.

1984
THE GRIZZLY BEAR.

ALFRED A. KNCPF, NEW YCRK. 308 PP.

GEN BIOL MGMT GEN

,GEN , , ,

00794

MEAGHER, M.

1977
EVALUATICN OF BEAR MANAGEMENT IN YELLOWSTCNE NATIONAL PARK, 1976.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. RES. NOT
E NO. 7. 11 PP.

CONTROL MGMT GEN PRES DISTR HUMAN INJ
MORT DATA AGE/SEX

YGBE,IMW ,YNP , ,

00795

MEAGHER, M.

1978
EVALUATION OF BEAR MANAGEMENT IN YELLOWSTONE NATIONAL PARK, 1977.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. RES. NOT
E NO. 8. 18 PP.

MGMT GEN HUMAN INJ CCNTROL AGE/SEX
MONIT SYS

YGBE,IMW ,YNP , ,

00796

MEAGHER, M. AND J.R. PHILLIPS.

1983
RESTORATION OF NATURAL POPULATIONS CF GRIZZLY AND BLACK BEARS IN
YELLOWSTONE NATIONAL PARK.

INT. CONF. BEAR RES. AND MANAGE. 5:152-158.

MGMT GEN RECR MGMT CCNTROL HUMAN INJ
RELOC GARBAGE GARB MGMT

YGBE,IMW ,YNP , ,

00797

MEALEY, S.P.

1975
THE NATURAL FOOD HABITS OF FREE RANGING GRIZZLY BEARS IN YELLOWST
ONE NATIONAL PARK, 1973-1974.

M.S. THESIS, MONT. STATE UNIV., BOZEMAN. 158 PP.

FOOD HAB USE NUTR ANAL DIGEST
PRED SEAS BEH CARCASS

YGBE,WY ,YNP , ,

00798

MEALEY, S.P.

1976
A SURVEY FOR GRIZZLY BEAR HABITAT ON THE MOUNT HEGBEN WINTER SPOR
TS SPECIAL USE APPLICATION SITE AND ADJACENT AREAS.

PREP. FOR SKI YELLOWSTONE INC., WEST YELLOWSTONE, MONT. 22 PP.

HAB RECON HAB EFFECT MGMT GEN

YGBE,MT ,GANF, ,SKYL

00799

MEALEY, S.P.

1979A
METHOD FOR DETERMINING GRIZZLY BEAR HABITAT QUALITY AND ESTIMATIN
G CONSEQUENCES OF IMPACTS ON GRIZZLY HABITAT QUALITY.

APPENDIX 7. PP. 79-130 IN: S.P. MEALEY, ED. GUIDELINES FOR MANAGE
MENT INVOLVING GRIZZLY BEARS IN THE GREATER YELLOWSTONE AREA. U.S
.D.I., NATL. PARK SERV. AND U.S.D.A., FOREST SERV.

HAB SAMPL MAP/TYPE CUM EFF FOOD
HAB USE FIRE MGMT LIVESTK MGMT TIMB MGMT
TERR/SPACE
YGBE,IMW ,USFS,YNP ,

00800

MEALEY, S.P. (ED.).

1979B
GUIDELINES FOR MANAGEMENT INVOLVING GRIZZLY BEARS IN THE GREATER
YELLOWSTONE AREA.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. AND U.S.
D.A., FOREST SERV., BRIDGER-TETON, SHOSHONE, CUSTER, GALLATIN AND
TARGHEE NATL. FORESTS. 136 PP.

MGMT PLAN ZONING TIMB MGMT FIRE MGMT
LIVESTK MGMT CAMP MGMT NONMOT MGMT MOTOR MGMT
ENERGY MGMT
YGBE,IMW ,USFS,YNP ,

00801

MEALEY, S.P.

1980
THE NATURAL FOOD HABITS OF GRIZZLY BEARS IN YELLOWSTONE NATIONAL PARK, 1973-74.

INT. CONF. BEAR RES. AND MANAGE. 4:281-292.

FOOD	SCAT ANAL	NUTR ANAL	HAB USE
FEED BEH	SEAS BEH	PRED	DIGEST

YGBE,IMW ,YNP , ,

00802

MEALEY, S.P. (ED.).

1986
INTERAGENCY GRIZZLY BEAR GUIDELINES.

U.S.D.A., FOREST SERV., U.S.D.I., NATL. PARK SERV., BUREAU OF LAND MGMT., IDAHO FISH AND GAME, MONTANA DEPT. FISH, WILDLIFE, AND PARKS, WASHINGTON GAME DEPT., WYOMING GAME AND FISH DEPT. 99 PP.

MGMT PLAN	ZONING	TIMB MGMT	FIRE MGMT
LIVESTK MGMT	CAMP MGMT	NONMOT MGMT	MOTOR MGMT
ENERGY MGMT			

,GEN , , ,

00803

MEALEY, S.P., C. JONKEL AND R. DEMARCHI.

1977
HABITAT CRITERIA FOR GRIZZLY BEAR MANAGEMENT.

PROC. INT. CONGR. GAME BIOL. 13:276-289.

HAB EFFECT	FOOD	FIRE MGMT	TIMB-METH
TIMB IMP			

,CAUS, , ,

00804

MEALEY, S.P., L. MARCUM, R. RIGHTER, C. JONKEL AND G. JOSLIN.

1976
VEGETATION STUDIES OF DISTURBED GRIZZLY HABITAT.

PP. 5-34 IN: C. JONKEL, ED. ANNUAL REPORT NO. 1. BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA.

HAB EFFECT	BURN USE/MGT	CUT USE	TIMB-HAB
TIMB-METH	TIMB-POST	ROAD MGMT	FIRE MGMT

NCDE,MT ,LONF,FLNF,WHR

00805

MECH, L.D., R.C. CHAPMAN, W.W. COCHRAN, L. SIMMONS AND U.S. SEAL.

1984
RADIO-TRIGGERED ANESTHETIC-DART COLLAR FOR RECAPTURING LARGE MAMM
ALS.

WILDL. SOC. BULL. 12:69-74.

DRUGS CAPTURE TELEM

,GEN , , ,

00806

MEEHAN, W.R.

1961
OBSERVATIONS ON FEEDING HABITS AND BEHAVIOR OF GRIZZLY BEARS.

AM. MIDL. NAT. 65(2):409-412.

FOOD CARCASS INTRASP BEH AGON
TERR/SPACE

BC-C,BC , , ,NAKR

00807

MEEHAN, W.R.

1974
THE FOREST ECOSYSTEM OF SOUTHEAST ALASKA, PART 4 - WILDLIFE HABIT
ATS.

U.S.D.A., FOREST SERV., PACIFIC NORTHWEST FOR. AND RANGE EXPT. ST
AT., PORTLAND, OREG. GEN. TECH. REP. PNW-16.

TIMB IMP

AKSE,AK , , ,

00808

MEEHAN, W.R. AND J.F. THILENIUS.

1983
SAFETY IN BEAR COUNTRY: PROTECTIVE MEASURES AND BULLET PERFORMANC
E AT SHORT RANGE.

U.S.D.A., FOREST SERV., PACIFIC NORTHWEST FOR. AND RANGE EXPT. ST
AT., PORTLAND, OREG. GEN. TECH. REP. PNW-152. 16 PP.

CONTROL

,AK , , ,

00809

MEHRHOFF, L.A.

1981
FORMAL SECTION 7 CONSULTATION REGARDING SHEEP GRAZING IN ESSENTIA
L GRIZZLY BEAR HABITAT ON THE TARGHEE NATIONAL FOREST.

U.S.D.I., FISH AND WILDL. SERV., BOISE, IDAHO. CONSULTATION NO. 1
-4-81-F-415. 8 PP.

LIVESTK IMP   LIVESTK MGMT

YGBE,IDWY,TANF,   ,

00810

MELQUIST, W.

1985
A PRELIMIARY SURVEY TO DETERMINE THE STATUS OF GRIZZLY BEARS (URS
US ACTOS HORRIBILIS) IN THE CLEARWATER NATIONAL FOREST OF IDAHO.

IDAHO COOP. WILDL. RES. UNIT, UNIV. IDAHO, MOSCOW. 54 PP.

PRES DISTR   CENSUS/TREND   HIST DISTR

SBE ,ID ,CLNF,   ,

00811

MERRIAM, C.H.

1904
FOUR NEW BEARS FROM NORTH AMERICA.

PROC. BIOL. SOC. WASH. 17:153-155.

TAXON/EVOL

,GEN ,   ,   ,

00812

MERRIAM, C.H.

1914
DESCRIPTIONS OF THIRTY APPARENTLY NEW GRIZZLY AND BROWN BEARS FRO
M NORTH AMERICA.

PROC. BIOL. SOC. WASH. 27:173-196.

TAXON/EVOL

,GEN ,   ,   ,

00813

MERRIAM, C.H.

1916
NINETEEN APPARENTLY NEW GRIZZLY AND BROWN BEARS FROM WESTERN AMERICA.

PROC. BIOL. SOC. WASH. 29:133-154.

TAXON/EVOL

,GEN , , ,

00814

MERRIAM, C.H.

1918
REVIEW OF THE GRIZZLY AND BIG BROWN BEARS OF NORTH AMERICA (GENUS URSUS) WITH DESCRIPTION OF A NEW GENUS, VETULARCTOS.

U.S.D.A., BUR. OF BIOL. SURVEY, NORTH AM. FAUNA SER. NO. 41. 133 PP.

TAXON/EVOL

,GEN , , ,

00815

MERRIAM, C.H.

1922
DISTRIBUTION OF GRIZZLY BEARS IN U.S.

OUTDOOR LIFE 50(6):405-406.

HIST DISTR

,US , , ,

00816

MERRILL, E.H.

1978
BEAR DEPREDATIONS AT BACKCOUNTRY CAMPGROUNDS IN GLACIER NATIONAL PARK.

WILDL. SOC. BULL. 6(3):123-127.

DEPRED HUMAN INJ CAMP MGMT

NCDE,MT ,GLNP, ,

00817

MEYER, W.H.

1978
FORMAL SECTION 7 CONSULTATION REGARDING THE EFFECT OF TIMBER MANAGMENT ON THE TARGHEE NATIONAL FOREST ON GRIZZLY BEARS.

U.S.D.I., FISH AND WILDL. SERV., PORTLAND, OREGON. CONSULTATION NO. 1-4-78F-51. 5 PP.

ROAD MGMT   TIMB-METH   TIMB-ENTRY   TIMB-POST

YGBE,ID ,TANF, ,

00818

MEYER, W.H.

1980
FORMAL SECTION 7 CONSULTATION ON THE USE OF STRYCHNINE BAITS FOR POCKET GOPHER CONTROL WITHIN GRIZZLY BEAR HABITAT ON THE TARGHEE NATIONAL FOREST.

U.S.D.I., FISH AND WILDL. SERV., PORTLAND, OREGON. 12 PP.

POISON

YGBE,ID ,TANF, ,

00819

MIHALIC, D.A.

1974
VISITOR ATTITUDES TOWARD GRIZZLY BEARS IN GLACIER NATIONAL PARK, MONTANA.

M.S. THESIS, MICH. STATE UNIV., EAST LANSING. 131 PP.

MGMT GEN   PUBLIC ATT   EDUC

NCDE,MT ,GLNP, ,

00820

MILLER, G.D.

1980
BEHAVIORAL AND PHYSIOLOGICAL CHARACTERISTICS OF GRIZZLY AND POLAR BEARS AND THEIR RELATION TO BEAR REPELLENTS.

M.S. THESIS, UNIV. MONT., MISSOULA. 106 PP.

TEMP   HEART   DETER/REPEL

,GEN , , ,

C0821

MILLER, G.D.

1983
RESPONSE OF CAPTIVE GRIZZLY AND POLAR BEARS TO POTENTIAL REPELLEN
TS.

INT. CONF. BEAR RES. AND MANAGE. 5:275-279.

DETER/REPEL

,GEN , , ,

00822

MILLER, G.D.

IN PRESS
FIELD TESTS OF POTENTIAL POLAR BEAR REPELLANTS.

INT. CONF. BEAR RES. AND MANAGE. 6.

DETER/REPEL

,GEN , , ,

00823

MILLER, G.S., JR.

1924
LIST OF NORTH AMERICAN RECENT MAMMALS.

U.S. NATL. MUS. BULL. NO. 128. GOV. PRINTING OFF., WASHINGTON, D.
C. 673 PP.

TAXON/EVOL

,GEN , , ,

00824

MILLER, R.L. AND G.B. WILL.

1976
USE OF M99 ETORPHINE AND ANTAGONISTS TO IMMOBILIZE AND HANDLE BLA
CK BEARS.

INT. CONF. BEAR RES. AND MANAGE. 3:225-234.

DRUGS

,GEN , , ,

00825

MILLER, S.D.

1983
BIG GAME STUDIES: VOL. VI BLACK BEAR AND BROWN BEAR.

SUSITNA HYDROELECTRIC PROJECT PHASE II, PROG. REP. ALASKA DEP. FI SH AND GAME, JUNEAU.

AGE/SEX		WEIGHT	REP RATE
MORT RATE	HOME RNG	FOOD	DEN
ENERGY IMP			

AKSC,AK , , ,NESU

00826

MILLER, S.D.

1984
BIG GAME STUDIES: VOL. VI BLACK BEAR AND BROWN BEAR.

SUSITNA HYDROELECTRIC PROJECT 1983 ANNUAL REP. ALASKA DEP. OF FIS H AND GAME, JUNEAU. 174 PP.

REP RATE	HARV DATA	MOVE	HOME RNG
POP DENS	DEN	WEIGHT	INTRASP BEH
POP BIOL			

AKSC,AK , , ,NESU

00827

MILLER, S.D.

1985A
BIG GAME STUDIES: VOL. VI BLACK BEAR AND BROWN BEAR.

SUSITNA HYDROELECTRIC PROJECT PHASE II PROG. REP. ALASKA DEP. FIS H AND GAME. JUNEAU, AK. 142 PP.

DEMOG ANAL	HOME RNG	MOVE	DEN
PRED	WEIGHT	CENSUS METH	POP DENS

AKSC,AK , , ,NESU

00828

MILLER, S.D.

1985B
AN OBSERVATION OF INTER- AND INTRA-SPECIFIC AGGRESSION INVOLVING BROWN BEAR, BLACK BEAR, AND MOOSE IN SOUTHCENTRAL ALASKA.

J. MAMMAL. 66(4):805-806.

INTRASP BEH	INTERSP COMP	PRED	TERR/SPACE
AGON	MATERNAL		

AKSC,AK , , ,NESU

C0829

MILLER, S. AND W.B. BALLARD.

1980
ESTIMATES OF THE DENSITY, STRUCTURE AND BIOMASS OF AN INTERIOR AL
ASKA BROWN BEAR POPULATION.

APPENDIX V. PP.82-123 IN: W.B. BALLARD. NELCHINA MOOSE CALF MORTA
LITY STUDIES. FED. AID WILDL. REST. PROJ. W-17-9, W-17-10, W-17-1
1 AND W-21-1, JOB 1.23R. ALASKA DEP. FISH AND GAME, JUNEAU.

CENSUS METH　　POP EST　　POP DENS　　HEMAT
MEAS/QUANT　　WEIGHT　　HOME RNG　　MOVE
AGE/SEX
AKSC,AK , , ,NESU

C0830

MILLER, S.D. AND W.B. BALLARD.

1982A
DENSITY AND BIOMASS ESTIMATES FOR AN INTERIOR ALASKAN BROWN BEAR,
URSUS ARCTOS, POPULATION.

CAN. FIELD - NAT. 96(4):448-454.

POP EST　　CENSUS METH　　POP DENS

AKSC,AK , , ,NESU

00831

MILLER, S.D. AND W.B. BALLARD.

1982B
HOMING OF TRANSPLANTED ALASKAN BROWN BEARS.

J. WILDL. MANAGE. 46(4):869-876.

RELOC　　MOVE　　ROAD IMP　　MATERNAL

AKSC,AK , , ,NESU

00832

MILLER, S.D., E.F. BECKER AND W.B. BALLARD.

IN PRESS
DENSITY ESTIMATES USING MODIFIED CAPTURE-RECAPTURE TECHNIQUES FOR
BLACK AND BROWN BEAR POPULATIONS IN ALAKSA.

INT. CONF. BEAR RES. AND MANAGE. 7.

CENSUS METH　　POP DENS　　AGE/SEX

AKSC,AK , , ,NESU

00833

MILLER, S.D. AND M.A. CHIHULY.

IN PRESS
CHARACTERISTICS OF NONSPORT BROWN BEAR DEATHS IN ALASKA.

INT. CONF. BEAR RES. AND MANAGE. 7.

MORT DATA HARV DATA AGE/SEX HUMAN IMP

,AK , , ,

00834

MILLER, S.D. AND D.C. MCALLISTER.

1981
BIG GAME STUDIES: PART VII, BLACK BEAR AND BROWN BEAR.

SUSITNA HYDROELECTRIC PROJECT. ALASKA DEP. FISH AND GAME, JUNEAU.

AGE/SEX WEIGHT HARV DATA MOVE
DEN SITE POP DENS

AKSC,AK , , ,NESU

00835

MILLER, S.J., N. BARICHELLO AND D. TAIT.

1982
THE GRIZZLY BEARS OF THE MACKENZIE MOUNTAINS, NORTHWEST TERRITORI
ES.

COMPLETION REP. N.W.T. WILDL. SERV., YELLOWKNIFE. 118 PP.

GEN DATA MEAS/QUANT DEN REP RATE
MORT RATE POP DENS PRED MORT DATA

NINT,NWT , , ,MMTN

00836

MODAFERRI, R.D.

1984
REVIEW OF ALASKA PENINSULA BROWN BEAR INVESTIGATIONS.

FED. AID WILDL. REST. PROJ. W-17-10, W-17-11, W-21-1, W-21-2 AND
W-22-1, JOB 4.12R. FINAL REP. ALASKA DEP. FISH AND GAME, JUNEAU.
43 PP.

COURT REPRO BRD AGE REPRO PHYS
LITR SIZE MORT RATE WEAN AGE/SEX
HARV DATA
AKPN,AK , , ,BLKL

00837

MOEN, A.N. AND L. ROGERS.

1985
RADIANT SURFACE TEMPERATURES AND HAIR DEPTHS OF A BLACK BEAR, URS US AMERICANUS.

CAN. FIELD-NAT. 99(1):47-50.

TEMP PELAGE MORPH/PHYS

,GEN , , ,

00838

MOHR, C.O.

1947
TABLE OF EQUIVALENT POPULATIONS OF NORTH AMERICAN SMALL MAMMALS.

AM. MIDL. NAT. 37:223-249.

HOME RNG

,GEN , , ,

00839

MONTANA DEPT. OF FISH, WILDLIFE AND PARKS.

1985
DESIGN FOR TOMORROW 19850l190: A STRATEGIC PLAN FOR MANAGEMENT OF MONTANA.

MONTANA DEPT. FISH AND WILDL. PARKS, HELENA. 88 P.

MGMT GEN

,MT , , ,

00840

MONTANA DEPARTMENT OF STATE LANDS.

1986
PRELIMINARY FINAL JARDINE JOINT VENTURE EIS.

MONTANA DEPT. STATE LANDS, HELENA. (INTERNAL REVIEW DRAFT).

ENERGY IMP ENERGY MGMT

YGBE,MT ,GANF, ,JARD

00841

MONTANA DEPT. OF FISH, WILDLIFE AND PARKS.

1986A
1986 GRIZZLY HUNTING SEASON CLOSED.

MONT. DEPT. FISH, WILDL. AND PARKS. NEWS RELEASE, 17 OCT. 1976.
2 PP.

HARV MGMT HARV DATA

,MT , , ,

00842

MONTANA DEPT. OF FISH, WILDLIFE AND PARKS.

1986B
1986 GRIZZLY BEAR REGULATIONS.

MONTANA DEPT. OF FISH, WILDL. AND PARKS. 6 PP.

HARV MGMT

,MT , , ,

00843

MOORE, G.L. AND S.M. GILBERT.

1977
GRIZZLY BEAR HABITAT STUDY.

PREP. FOR U.S.D.A., FOREST SERV. CONTRACT 262-50. PREP. BY OLSON-
ELLIOTT AND ASSOC., HELENA, MONT. 73 PP.

MAP/TYPE HAB RECON

CYE ,IDMT,KONF, ,

00844

MOORE, T.D., L.E. SPENCE AND C.E. DUGNOLLE.

1974
IDENTIFICATION OF THE DORSAL GUARD HAIRS OF SOME MAMMALS OF WYOMI
NG.

WYO. GAME AND FISH DEP., LARAMIE. BULL. NO. 14. 186 PP.

HAIR

,GEN , , ,

00845

MOORE, W.R.

1984
LAST OF THE BITTERROOT GRIZZLY.

MONTANA MAG. 68:8-12.

HIST DISTR HIST ACCT HUMAN IMP

SBE ,IDMT, , ,

00846

MOULTON, J.E.

1961
BILE DUCT CARCINOMAS IN TWO BEARS.

CORNELL VET. 61(2):285-293.

PARAS/DIS

,GEN , , ,

00847

MUMMA, J.W.

1979
MINUTES FROM GRIZZLY BEAR MEETING - FEBRUARY 8, 1979, ST. ANTHONY
, IDAHO.

U.S.D.A., FOREST SERV., TARGHEE NATL. FOREST, ST. ANTHONY, IDAHO.
4 PP.

TIMB MGMT POISON

YGBE,ID ,TANF, ,

00848

MUNDY, K.R.D.

1963
ECOLOGY OF THE GRIZZLY BEAR (URSUS ARCTOS, L.) IN GLACIER NATIONA
L PARK, BRITISH COLUMBIA.

M.S. THESIS, UNIV. ALBERTA, EDMONTON. 103 PP.

GEN DATA MEAS/QUANT REP RATE POP EST
GROW/DEV AGE DETERM PARAS/DIS REPRO PHYS
AGON
BC-I,BC ,CGNP, ,

C0849

MUNDY, K.R.D.

1971
BIBLIOGRAPHY OF BEARS.

B.C. FISH AND WILDL. BRANCH, CRANBROOK. TECH. BULL. NO. 1. 30 PP.

BIBLIO

,GEN , , ,

00850

MUNDY, K.R.D. AND D.R. FLOOK.

1965
NOTES ON THE MATING ACTIVITY OF GRIZZLY AND BLACK BEARS.

J. MAMMAL. 45(4):637-638.

COPULATE THREAT COURT

BC-I,BC ,CGNP, ,

00851

MUNDY, K.R.D. AND D.R. FLOOK.

1970
ECOLOGICAL STUDIES OF GRIZZLY BEARS IN THE NATIONAL PARKS OF CANA
DA.

CAN. WILDL. SERV. 99 PP.

GEN DATA POP BIOL MEAS/QUANT GARB MGMT
NONMOT MGMT HUMAN INJ POP EST INTRASP BEH
INTERSP COMP
BC-I,BC ,CGNP, ,

00852

MUNDY, K.R.D. AND D.R. FLOOK.

1973
BACKGROUND FOR MANAGING GRIZZLY BEARS IN THE NATIONAL PARKS OF CA
NADA.

CAN. WILDL. SERV. REP. SER. NO. 22. 35 PP.

POP EST POP DENS REP RATE GEN DATA
REPRO PHYS PARAS/DIS GARBAGE CONTROL
INTRASP BEH
BC-I,BC ,CGNP, ,

00853

MUNDY, K.R.D. AND W.A. FULLER.

1964
AGE DETERMINATION IN THE GRIZZLY BEAR.

J. WILDL. MANAGE. 28(4):863-866.

AGE DETERM   SKULL   DENT

,GEN ,   ,   ,

00854

MURIE, A.

1944
THE WOLVES OF MOUNT MCKINLEY.

U.S.D.I., NATL. PARK SERV., FAUNA SER. NO. 5, U.S. GOV. PRINTING OFF., WASHINGTON, D.C., 238 PP.

INTERSP COMP   PRED

,AK   ,   ,   ,

00855

MURIE, A.

1948
CATTLE ON GRIZZLY BEAR RANGE.

J. WILDL. MANAGE. 12(1):57-72.

DEPRED   HIST ACCT

YGBE,WY ,BTNF,   ,

00856

MURIE, A.

1981
THE GRIZZLIES OF MOUNT MCKINLEY.

U.S.D.I., NATL. PARK SERV. SCI. MONOGR. SER. NO. 14. U.S. GOV. PRINTING OFF., WASHINGTON, D.C. 251 PP.

MOVE   TERR/SPACE   AGON   MATERNAL
INTERSP COMP   COURT   FOOD   PRED
CARCASS
AK-I,AK ,DENP,   ,

00857

MURIE, O.J.

1944
PROGRESS REPORT ON THE YELLOWSTONE BEAR STUDY.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. 13 PP.

MGMT GEN FOOD GARBAGE GARB MGMT

YGBE,WY ,YNP , ,

00858

MYSTERUD, I.

1973
BEHAVIOR OF THE BROWN BEAR (URSUS ARCTOS) AT MOOSE KILLS.

NORW. J. ZOOL. 21:267-272.

PRED FEED BEH INTERSP COMP

,GEN , , ,

C0859

NAGY, J.A.

1984
RELATIONSHIP OF WEIGHT TO CHEST GIRTH IN THE GRIZZLY BEAR.

J. WILDL. MANAGE. 48(4):1439-1440.

WEIGHT GIRTH

,CAN , , ,TUKP

C0860

NAGY, J.A. AND R.H. RUSSELL.

1978
ECOLOGICAL STUDIES OF THE BOREAL FOREST GRIZZLY BEAR (URSUR ARCTO
S L.) - ANNUAL REPORT FOR 1977.

CAN. WILDL. SERV. 72 PP.

GEN DATA POP BIOL POP DENS INTERSP COMP
MEAS/QUANT HARV DATA GROW/DEV WEAN
PELAGE
BORF,AT , , ,SWHI

00861

NAGY, J.A., R.H. RUSSELL, A.M. PEARSON, M.C. KINGSLEY, AND B.C. GOS
KI.
1983A
ECOLOGICAL STUDIES OF THE GRIZZLY BEAR IN ARCTIC MOUNTAINS, NORTH
ERN YUKON TERRITORY, 1972 TO 1975.

CAN. WILDL. SERV. 104 PP.

DRUGS	MEAS/QUANT	GEN DATA	DEN
REP RATE	MORT DATA	POP DENS	POP BIOL
COURT			

CARC,YK , , ,

00862

NAGY, J.A., R.H. RUSSELL, A.M. PEARSON, M.C. KINGSLEY, AND C.B. LAR
SEN.
1983B
A STUDY OF GRIZZLY BEARS ON THE BARREN GROUNDS OF TUKTOYAKTUK PEN
INSULA AND RICHARDS ISLAND, NORTHWEST TERRITORIES, 1974 TO 1978.

CAN. WILDL. SERV. 136 PP.

REP RATE	GEN DATA	POP BIOL	HARV IMP
HARV MGMT	MEAS/QUANT	MORT DATA	DEN
POP DENS			

CARC,NWT , , ,TUKP

00863

NATIONAL PARK SERVICE.

1967
GRIZZLY BEAR ATTACKS AT GRANITE PARK AND TROUT LAKE IN GLACIER NA
TIONAL PARK, AUGUST 13, 1967.

U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 22 PP.

HUMAN INJ

NCDE,MT ,GLNP, ,

00864

NATIONAL PARK SERVICE.

1982
FINAL ENVIRONMENTAL IMPACT STATEMENT GRIZZLY BEAR MANAGEMENT PROG
RAM.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. 202 PP.

MGMT PLAN	DEPRED	GARB MGMT	HUMAN INJ
CONTROL	GEN DATA	CLOSURE	MONIT SYS

YGBE,IMW ,YNP , ,

00865

NATIONAL PARK SERVICE.

1984A
BEAR/HUMAN CONFLICT MANAGEMENT ACTION PLAN.

U.S.D.I., NATL. PARK SERV., DENALI NATL. PARK, AK.

MGMT PLAN	RECR MGMT	CLOSURE	AVER COND
RELOC	GARB MGMT	EDUC	LEGAL
MONIT SYS			

AK-I,AK ,DENP, ,

00866

NATIONAL PARK SERVICE.

1984B
YELLOWSTONE OPERATING PROCEDURE: BEAR MANAGEMENT POLICY.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. 7 PP.

EDUC	MOTOR MGMT	NONMOT MGMT	GARB MGMT

YGBE,IMW ,YNP , ,

00867

NATIONAL PARK SERVICE.

1984C
BOARD OF INQUIRY INTO THE DEATH OF: BRIGITTA FREDENHAGEN.

U.S.D.I., NATL. PARK SERV. 4 PP.

HUMAN INJ

YGBE,WY ,YNP , ,WHIL

C0868

NATIONAL PARK SERVICE.

1984D
FISHING BRIDGE AND THE YELLOWSTONE ECOSYSTEM. A REPORT TO THE DIR
ECTOR. NOVEMBER 1984.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. 151 PP.

CONTROL	RECR IMP	HUMAN INJ	RELOC
MORT DATA	HAB USE	FOOD	PRED
PRES DISTR			

YGBE,WY ,YNP , ,FISH

00869

NATIONAL PARK SERVICE.

1984E
BROWN BEAR INCIDENT AND MANAGEMENT ACTION REPORT.

U.S.D.I., NATL. PARK SERV., KATMAI NATL. PARK AND PRESERVE, ALASK
A. 3 PP.

CONTROL HUMAN INJ DEPRED

AKPN,AK ,KANM, ,

00870

NATIONAL PARK SERVICE.

1985A
BEAR MANAGEMENT PLAN.

U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 19 PP + APP
S.

MGMT PLAN EDUC GARB MGMT CAMP MGMT
CONTROL RELOC CLOSURE MONIT SYS
NONMOT MGMT
NCDE,MT ,GLNP, ,

00871

NATIONAL PARK SERVICE.

1985B
ANNUAL BEAR MANAGEMENT PLAN, YELLOWSTONE NATIONAL PARK, 1985 SEAS
ON.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. 5 PP.

MGMT PLAN RECR MGMT EDUC

YGBE,IMW ,YNP , ,

00872

NATIONAL PARK SERVICE.

1985C
BEAR MANAGEMENT HUMAN USE ADJUSTMENT, YELLOWSTONE NATIONAL PARK.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. 20 PP.

NONMOT MGMT CLOSURE

YGBE,IMW ,YNP , ,

00873

NATIONAL PARK SERVICE.

1985D
SUMMARIES OF BEAR CONTROL ACTIONS, MANAGEMENT REMOVALS, BEAR INJU
RIES, AND CONFRONTATIONS.

U.S.D.I., NATL. PARK SERV., YELLOWSTONE NATL. PARK, WYO. 19 PP.

CONTROL RELOC HUMAN INJ REACTION

YGBE,IMW ,YNP , ,

00874

NATL. PARK SERVICE AND U.S. FOREST SERVICE

1985
OUTFITTER POLICY: GREATER YELLOWSTONE AREA.

U.S.D.I., NATL. PARK SERV. AND U.S.D.A., FOREST SERV. 76 PP.

OUTFIT MGMT CAMP MGMT

YGBE,IMW , , ,

00875

NEILAND, K.A.

1974A
CARIBOU DISEASE REPORT.

FED. AID WILDL. REST. PROJ. W-17-5 AND W-17-6, JOB 3.9R. PROG. RE
P. VOL. XV., JAN. 1, 1973-DEC. 31, 1973. ALASKA DEP. FISH AND GAM
E, JUNEAU. 33 PP.

PARAS/DIS REPRO

ARC ,AK , , ,BRKR

00876

NEILAND, K.A.

1974B
FURTHER SEROLOGIC OBSERVATIONS ON THE OCCURRENCE OF RANGIFERINE B
RUCELLOSIS IN SOME ALASKAN CARNIVORES.

PP. 4-25 IN: K.A. NEILAND. CARIBOU DISEASE REPORT. FED. AID WILDL
. REST. PROJ. W-17-5 AND W-17-6, JOB 3.9R. PROG. REP. VOL. XV., J
AN. 1, 1973-DEC. 31, 1973. ALASKA DEP. FISH AND GAME, JUNEAU.

PARAS/DIS REPRO

ARC ,AK , , ,BRKR

00877

NEILAND, K.A.

1975
FURTHER OBSERVATIONS ON RANGIFERINE BRUCELLOSIS IN ALASKAN CARNIV ORES.

J. WILDL. DISEASES 11(1):45-53.

PARAS/DIS REPRO

ARC ,AK , , ,BRKR

00878

NEILAND, K.A.

1979
CARIBOU DISEASE STUDIES.

FED. AID WILDL. REST. PROJ. W-17-4 TO W-17-6, JOB 3.9R. FINAL REP ., JULY 1, 1971-JUNE 20, 1978. ALASKA DEP. FISH AND GAME, JUNEAU. 33 PP.

PARAS/DIS

,AK , , ,

00879

NEILAND, K.A. AND L.G. MILLER.

1979
OBSERVATIONS ON EXPERIMENTAL RANGIFERINE BRUCELLOSIS INFECTIONS I N DOMESTIC AND WILD ALASKAN CARNIVORES.

APPENDIX II. PP. 39-68 IN: K.A. NEILAND. CARIBOU DISEASE STUDIES. FED. AID WILDL. REST. PROJ. W-17-4 TO W-17-6, JOB 3.9R. FINAL RE P., JULY 1, 1971-JUNE 30, 1978. ALASKA DEP. FISH AND GAME, JUNEAU . 33 PP.

PARAS/DIS

,AK , , ,

00880

NEILAND, K.A. AND L.G. MILLER.

1981
EXPERIMENTAL BRUCELLA SUIS TYPE 4 INFECTIONS IN DOMESTIC AND WILD ALASKAN CARNIVORES.

J. WILDL. DIS. 17(2):183:189.

PARAS/DIS

,AK , , ,

00881

NELSON, D.C.

1976
RUSSIAN RIVER RED SALMON STUDY.

ANADROMOUS FISH STUDIES, STUDY AFS 44-2. ANNU. PERFORMANCE REP. V
CL. 17. ALASKA DEP. FISH AND GAME, JUNEAU. 71 PP.

PRED

AKPN,AK , , ,KENA

00882

NELSON, R.A.

1973
WINTER SLEEP IN THE BLACK BEAR. A PHYSIOLOGIC AND METABOLIC MARVE
L.

MAYO CLIN. PROC. 48:733-737.

HIB PHYS HEMAT TEMP HEART

,GEN , , ,

00883

NELSON, R.A.

1978
UREA METABOLISM IN THE HIBERNATING BLACK BEAR.

KIDNEY INTER. 13(SUPPL. 8):S177-S179.

HIB PHYS HEMAT

,GEN , , ,

00884

NELSON, R.A.

1980
PROTEIN AND FAT METABOLISM IN HIBERNATING BEARS.

FED. PROC. 39(12):2955-2958.

HIB PHYS TEMP HEMAT

,GEN , , ,

00885

NELSON, R.A.

1984
HUMAN SPACE TRAVEL AND STRESS MANAGEMENT: LESSCNS FROM HIBERNATIN
G BEARS.

PP. 5-20 IN: J.E. HAMNER III, ED. THE 1984 DISTINGUISHED VISITING
PROFESSORSHIP LECTURES. UNIV. TENN. CENTER FOR HEALTH SCI., MEMP
HIS.

HIB PHYS HEMAT

,GEN , , ,

00886

NELSON, R.A. AND T.D.I. BECK.

1984
HIBERNATION ADAPTATION IN THE BLACK BEAR: IMPLICATIONS FOR MANAGE
MENT.

PROC. EAST. WORKSHOP BLACK BEAR MANAGE. AND RES. 7:48-53.

HIB PHYS HEMAT MGMT GEN SUPPL FEED

,GEN , , ,

00887

NELSON, R.A., T.D.I. BECK AND D.L. STEIGER.

1984
RATIO OF SERUM CREATININE IN WILD BLACK BEARS.

SCIENCE 226(4676):841-842.

HIB PHYS HEMAT

,GEN , , ,

00888

NELSON, R.A., G.E. FOLK, JR., E.W. PFEIFFER, J.J. CRAIGHEAC, C.J. J
ONKEL AND C.L. STEIGER.
1983A
BEHAVIOR, BIOCHEMISTRY, AND HIBERNATION IN BLACK, GRIZZLY, AND PO
LAR BEARS.

INT. CONF. BEAR RES. AND MANAGE. 5:284-290.

HIB PHYS SEAS BEH HEMAT

,GEN , , ,

C0889

NELSON, R.A., J.D. JONES, H.W. WAHNER, D.B. MCGILL AND C.F. CODE.

1975
NITROGEN METABOLISM IN BEARS: UREA METABOLISM IN SUMMER STARVATIO
N AND IN WINTER SLEEP AND ROLE OF URINARY BLADDER IN WATER AND NI
TROGEN CONSERVATION.

MAYO CLINIC PROC. 50:141-146.

HIB PHYS HEMAT PHYS CHEM

,GEN , , ,

C0890

NELSON, R.A., D.L. STEIGER AND T.D.I. BECK.

1983B
NEUROENDOCRINE AND METABOLIC INTERACTIONS IN THE HIBERNATING BLAC
K BEAR.

ACTA ZOOL. FENN. 174:137-141.

HIB PHYS

,GEN , , ,

00891

NELSON, R.A., N.W. WAHNER, J.D. JONES, R.D. ELLEFSON AND P.E. ZOLLM
AN.
1973
METABOLISM OF BEARS BEFORE, DURING, AND AFTER WINTER SLEEP.

AM. J. PHYSIOL. 224(2):491-496.

HIB PHYS HEMAT

,GEN , , ,

00892

NELSON, U.C.

1948
INVESTIGATIONS OF THE HISTORICAL AND CURRENT HARVEST OF FUR AND G
AME, PREDATORS TAKEN AND BOUNTIES PAID AND OTHER STATISTICS OF PE
RTINENT VALUE FOR THE MANAGEMENT OF ALASKAN WILDLIFE.

FED. AID WILDL. REST. PROJ W-3-R-4, JOB NO. 1, WORK PLAN 6. ALASK
A GAME COMMISSION, JUNEAU. 7 PP.

HARV DATA

,AK , , ,

00893

NELSON, U.C.

1951
INVESTIGATIONS AND COMPILATION OF THE HISTORIC AND CURRENT HARVES
T OF FUR AND GAME, PREDATORS TAKEN, BOUNTIES PAID AND OTHER STATI
STICS OF VALUE FOR THE MANAGEMENT OF ALASKAN WILDLIFE.

FED. AID WILDL. REST. PROJ W-3-R-5, WORK PLAN 7. ALASKA GAME COMM
ISSION, JUNEAU. 4 PP.

HARV DATA

,AK , , ,

00894

NELSON, U.C.

1955
COMPILATION OF DATA ON WILDLIFE HARVEST JULY 1, 1954 TO JUNE 30,
1955.

FED. AID WILDL. REST. PROJ. W-3-R-10, WORK PLAN D. ALASKA GAME CO
MMISSION, JUNEAU. 3 PP.

HARV DATA

,AK , , ,

00895

NEWBURN, A.M.

1951
BIG GAME, SMALL GAME AND FUR TAKE REPORT.

FED. AID WILDL. REST. PROJ. W-3R. ALASKA GAME COMMISSION, JUNEAU.
3 PP.

HARV DATA

,AK , , ,

00896

NIELSON, P.L.

1975
THE PAST AND PRESENT STATUS OF THE PLAINS AND BOREAL FOREST GRIZZ
LY BEAR IN ALBERTA.

CAN. WILDL. SERV. AND ALBERTA FISH AND WILDL. DIV. 65 PP.

HIST DISTR HIST ACCT PRES DISTR

,AT , , ,

00897

NOBLE, L.B.

1972
MAN AND GRIZZLY BEAR IN BANFF NATIONAL PARK, ALBERTA.

M.A. THESIS, UNIV. CALGARY, CALGARY. 119 PP.

HIST DISTR	HIST ACCT	POACH/ILLEG	HARV IMP
HARV DATA	CCNTROL	GARBAGE	RECR IMP
RECR MGMT			

CR ,AT ,BANP, ,

00898

NOBLE, W.

1985
SHEPHERDIA CANADENSIS: ITS ECOLOGY, DISTRIBUTION AND UTILIZATION BY THE GRIZZLY BEAR.

SENIOR THESIS, UNIV. MONTANA, MISSOULA. 29PP.

FIRE MGMT	FOOD	HAB USE	TIMB-POST

NCDE,BCMT, , ,NFLT

00899

NOLAN, J.W., R.H. RUSSELL AND F. ANDERKA.

1984
TRANSMITTERS FOR MONITORING ALDRICH SNARES SET FOR GRIZZLY BEARS.

J. WILDL. MANAGE. 48(3):942-945.

CAPTURE	TELEM

CR ,AT ,JANP, ,

C0900

NORTHWEST TERRITORIES RENEWABLE RESOURCES.

1986
SUMMARY OF HUNTING REGULATIONS.

NORTHWEST TERRIROTIES RENEWABLE RES.

HARV MGMT

,NWT , , ,

00901

OGILVIE, R.T. AND T. TOTH.

1983
VEGETATION CLASSIFICATION IN THE CASCADE VALLEY.

PP. 264-286 IN: D. HAMER AND S. HERRERO, EDS. ECOLOGICAL STUDIES OF THE GRIZZLY BEAR, BANFF NATIONAL PARK. PREP. FOR PARKS CANADA CONTRACT WR4-80. UNIV. CALGARY, ALBERTA. FINAL REP.

MAP/TYPE HAB USE

CR ,AT ,BANP, ,CASC

00902

OLSON, S.T.

1953
WINTER MORTALITY OF BLACK-TAILED DEER. FACTORS AFFECTING, EXTENT AND FREQUENCY.

FED. AID WILDL. REST. PROJ. W-3-R-7, JOB 1, WORK PLAN E. ALASKA G AME COMMISSION, JUNEAU. 2 PP.

CARCASS PRED

AKSE,AK , , ,

00903

OLSON, S.T.

1956
MANAGEMENT STUDIES OF ALASKA CARIBOU CALVING STUDIES - STEESE FOR TYMILE HERD.

FED. AID WILDL. REST. PROJ. W-3-R-11, JOB NO. 3-B, WORKPLAN NO. B . ALASKA GAME COMMISSION, JUNEAU. 5 PP.

PRED

AK-I,AK , , ,STEE

00904

OLSON, S.T.

1957
MANAGEMENT STUDIES OF ALASKA CARIBOU, SAMPLING OF KILL BY HUNTERS - STEESE-FORTYMILE HERD.

FED. AID WILDL. REST. PROJ W-3-R-11, JOB 1B. ALASKA GAME COMMISSI ON, JUNEAU. 4 PP.

HARV DATA

AK-I,AK , , ,STEE

C0905

CNISHAK, M. AND D.S. STOCKSTAD.

1957
PRELIMINARY GRIZZLY BEAR INVESTIGATIONS.

FED. AID WILDL. REST. PROJ. W-71-R-3, JOB 3, WORK PLAN A. JCB COM
PLETION REP., JUNE 1-OCT. 1, 1957. MONT. DEP. FISH AND GAME, HELE
NA. 12 PP.

HIST DISTR

NCDE,MT , , ,

C0906

CRME, M.L. AND R.G. WILLIAMS.

1986
COORDINATING LIVESTOCK AND TIMBER MANAGEMENT WITH THE GRIZZLY BEA
R IN SITUATION 1 HABITAT, TARGHEE NATIONAL FOREST.

PP. 195-203 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-G
RIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTA
IN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

TIMB-METH	TIMB-ENTRY	POISON	TIMB-POST
TIMB-HAB	LIVESTK MGMT	LIVESTK IMP	

YGBE,IDWY,TANF, ,

C0907

CSMUNDSON, C.

1983
THE RELOCATION OF TWO GRIZZLY YEARLINGS INTO THE YAAK, 1981.

BORDER GRIZZLY PROJ., UNIV. MONTANA, MISSOULA. 23 PP.

RELOC	INT/REINT	PUBLIC ATT	MOVE
HOME RNG	HAB USE	ACT PATT	DEN CHRCN
HIST DISTR			

CYE ,MT , , ,YAKR

00908

OTT, J.

1984
TRICHINELLA SPIRALIS AND ITS POSSIBLE RELATIONSHIP TO ABNORMAL BE
HAVIOR IN BEARS.

PREP. FOR SELKIRK COLLEGE, WILDLAND RECREATION II. 16 PP.

PARAS/DIS HUMAN INJ

,GEN , , ,

00909

PALMISCIANO, D.

1986
GRIZZLY MORTALITIES UPDATE.

MONT. DEP. OF FISH, WILDL., AND PARKS, BOZEMAN, MONT. 2 PP.

MORT DATA HARV DATA CONTROL POACH/ILLEG

,MT , , ,

C0910

PALOHEIMO, J.E. AND D. FRASER.

1981
ESTIMATION OF HARVEST RATE AND VULNERABILITY FROM AGE AND SEX DAT
A.

J. WILDL. MANAGE. 45(4):948-958.

CENSUS METH HARV MGMT AGE/SEX

,GEN , , ,

00911

PALUMBO, P.J., N.A. BAGLEY, D.L. WELLIK AND R.A. NELSON.

1983
INSULIN AND GLUCAGON RESPONSES IN THE HIBERNATING NORTH AMERICAN
BLACK BEAR.

INT. CONF. BEAR RES. AND MANAGE. 5:291-296.

HIB PHYS HEMAT

,GEN , , ,

00912

PARKS CANADA.

1984
BEAR MANAGEMENT PLAN, WATERTON LAKES NATIONAL PARK.

PARKS CANADA, WATERON LAKES NATL. PARK WARDEN SERVICE.

MGMT PLAN MGMT GEN GARB MGMT CLOSURE
CONTROL MONIT SYS

CR ,AT ,WANP, ,

00913

PARSONS, L.D.

1976
THE POSSIBLE AFFECT ON A RELICT GRIZZLY BEAR POPULATION OF LOOK-A
LIKE BLACK BEAR HUNTING IN WASHINGTON'S SELKIRK MOUNTAINS.

BORDER GRIZZLY TECHN. COMM., BORDER GRIZZLY PROJ., UNIV. MONT., M
ONT. WORKING PAP. 16 PP.

HARV IMP　　IDENT/RECOG　　EDUC

SME ,WA , , ,

00914

PARSONS, L.D.

1977
GRIZZLY BEAR SECTION.

PP. 62-72 IN: BIG GAME STATUS REPORT, 1976-1977. WASH. STATE GAME
DEP., OLYMPIA.

PUBLIC ATT　　EDUC　　IDENT/RECOG

SME ,WA , , ,

00915

PEACOCK, D.A.

1978
OBSERVATIONS OF GRIZZLY BEARS IN THE APGAR MOUNTAINS, GLACIER NAT
IONAL PAKR, MONTANA.

MANUSCRIPT, 45 PP.

GEN DATA　　CENSUS METH　　INTRASP BEH　　REACTION
BEHAV PATT　　MGMT GEN　　AIRCRAFT IMP　　POACH/ILLEG
PELAGE
NCDE,MT ,GLNP, ,APGR

00916

PEARSON, A.M.

1965A
STUDY OF THE GRIZZLY BEAR IN THE YUKON.

CAN. WILDL. SERV. PROJ. NO. M5-1-2. 1964 PROG. REP. 13 PP.

PELAGE　　ACT PATT　　FOOD　　REACTION
CENSUS METH　　MISC QUANT

NINT,YK ,KLGS, ,ALSE

00917

PEARSON, A.M.

1965B
STUDY OF THE GRIZZLY BEAR.

CAN. WILDL. SERV. PROJ. NO. M5-1-2. 1965 PROG. REP. 32 PP.

FOOD	HAB USE	CAPTURE	AGE/SEX
MISC QUANT	WEIGHT	LENGTH	DRUGS

NINT,YK ,KLGS, ,ALSE

00918

PEARSON, A.M.

1967
PROGRESS REPORT ON 1966 STUDY OF THE GRIZZLY BEAR - YUKON TERRITO
RY.

CAN. WILDL. SERV. PROJ. NO. 96-5-5-122. 40 PP.

HAB USE	AGE/SEX	MEAS/QUANT	WEIGHT
MOVE	AGE DETERM		

NINT,YK ,KLGS, ,ALSE

00919

PEARSON, A.M.

1968A
GRIZZLY BEARS IN THE YUKON TERRITORY.

PP. 40-42 IN: TRANS. 32ND FED.-PROV. WILDL. CONF., 9-11 JULY 1968
, WHITEHORSE, YUKON TERR. CAN. WILDL. SERV. REP. SER. NO. 32.

AGE/SEX	LITR SIZE	REP RATE	FOOD
WEIGHT	MOVE		

NINT,YK ,KLGS, ,ALSE

00920

PEARSON, A.M.

1968B
PROGRESS REPORT ON 1967 STUDY OF THE GRIZZLY BEAR.

CAN. WILDL. SERV. PROJ. NO. 122. 83 PP.

AGE DETERM	SKULL	AGE/SEX	MEAS/QUANT
MOVE	HAB USE	FOOD	PARAS/DIS

NINT,YK ,KLGS, ,ALSE

00921

PEARSON, A.M. (ED.)

1968C
PROCEEDINGS OF THE FIRST BEAR WORKSHOP.

PROC. FIRST INT. CONF. BEAR RES. AND MANAGE., AUGUST 1968, WHITEH
ORSE, CAN. WILDL. SERV. INT. ASSOC. BEAR RES. AND MANAGE. 63 PP.

GEN DATA	MGMT GEN	CENSUS/TREND	RECR MGMT
AGE DETERM	TELEM	DRUGS	DEN
POP BIOL			

,GEN , , ,

00922

PEARSON, A.M.

1972
POPULATION CHARACTERISTICS OF THE NORTHERN INTERIOR GRIZZLY IN TH
E YUKON TERRITORY, CANADA.

INT. CONF. BEAR RES. AND MANAGE. 2:32-35.

LITR SIZE	BRD AGE	MOVE	HOME RNG

NINT,YK ,KLGS, ,

00923

PEARSON, A.M.

1975
THE NORTHERN INTERIOR GRIZZLY BEAR URSUS ARCTOS L.

CAN. WILDL. SERV. REP. SER. NO. 34, OTTAWA. 86 PP.

DEMOG ANAL	GEN DATA	INTRASP BEH	MEAS/QUANT
REPRO PHYS	RES TECH	BEHAV PATT	REACTION
DEN			

NINT,YK ,KLGS, ,ALSE

00924

PEARSON, A.M.

1976A
THE BOREAL FOREST GRIZZLY BEAR, ANNUAL REPORT FOR 1975.

CAN. WILDL. SERV. 18 PP.

AGE/SEX	HOME RNG	DEN	FOOD
WEIGHT	LENGTH	MISC QUANT	SKULL

BORF,AT , , ,SWHI

00925

PEARSON, A.M.

1976B
POPULATION CHARACTERISTICS OF THE ARCTIC MOUNTAIN GRIZZLY BEAR.

INT. CONF. BEAR RES. AND MANAGE. 3:247-260.

GEN DATA　POP DENS　AGE/SEX　COURT
LITR SIZE　WEAN　CANNIBAL　DEN SITE
WEIGHT
CARC,YK , , ,BARN

00926

PEARSON, A.M.

1977
HABITAT, MANAGEMENT AND THE FUTURE OF CANADA'S GRIZZLY BEARS.

PP. 33-40 IN: PROC. SYMP. CANADA'S THREATENED SPECIES AND HABITAT
S.

PRES DISTR　FOOD　HARV MGMT　HOME RNG

,CAN , , ,

00927

PEARSON, A.M.

1980
THE POTENTIAL IMPACT OF THE DEMPSTER LATERAL GAS PIPELINE ON GRIZ
ZLY BEAR AND FOX IN THE MACKENZIE DELTA.

PREP. FOR FOOTHILLS PIPE LINES (YUKON) LTD., CALGARY, ALBERTA. 17
PP.

HAB USE　FOOD　DEN　ENERGY IMP

CARC,NWT , , ,RICH

00928

PEARSON, A.M., R.M. BRADLEY AND T.R. MCLAUGHLIN.

1968
EVALUATION OF PHECYCLIDINE HYDROCHLORIDE AND OTHER DRUGS FOR IMMO
BILIZING GRIZZLY AND BLACK BEARS.

J. WILDL. MANAGE. 32(3):532-537.

DRUGS

NINT,YK , , ,

00929

PEARSON, A.M. AND D.W. HALLORAN.

1972
HEMATOLOGY OF THE BROWN BEAR (URSUS ARCTOS) FROM SOUTHWESTERN YUK
ON TERRITORY, CANADA.

CAN. J. ZOOL. 50:279-286.

HEMAT

NINT,YK , , ,

00930

PEARSON, A.M., D.C. MORRISON AND N. OLSEN.

1967
A RECORD OF INTRASPECIFIC MORTALITY IN URSUS ARCTOS.

CAN. WILDL. SERVICE, EDMONTON. 4 PP.

AGON CANNIBAL

NINT,YK , , ,

00931

PEARSON, A.M. AND J. NOLAN.

1976
THE ECOLOGY OF THE GRIZZLY BEAR (URSUS ARCTOS L.) IN JASPER NATIO
NAL PARK - REPORT FOR 1975.

CAN. WILDL. SERV. 15 PP.

WEIGHT FOOD LENGTH HOME RNG
DEN AGE DETERM GIRTH

CR ,AT ,JANP, ,

00932

PELTON, M.R. AND L.C. MARCUM.

1977
THE POTENTIAL USE OF RADIOISOTOPES FOR DETERMINING DENSITIES OF B
LACK BEARS AND OTHER CARNIVORES.

PP. 221-236 IN: R.L. PHILLIPS AND C. JONKEL, EDS. PROC. 1975 PRED
ATOR SYMP., MONTANA FOR. AND CONSERV. EXP. STAT., UNIV. MONT., MI
SSOULA.

CENSUS METH

,GEN , , ,

00933

PERENSOVICH, M.M.

1963
BROWN BEAR PROGRESS REPORT. 1960 THRU 1962.

U.S.D.A., FOREST SERV., NORTH TONGASS NATL. FOREST, JUNEAU. 40 PP
.

CENSUS/TREND   HAB USE   HARV DATA

AKSE,AK ,TONF, ,

C0934

PERENSOVICH, M.M.

1964
BROWN BEAR STUDIES.

INTERIM REP. 1958-1963. U.S.D.A., FOREST SERV., NORTH TONGASS NAT
L. FOREST, JUNEAU. 42 PP.

CENSUS METH   LITR SIZE   TIMB IMP   HAB USE
HARV DATA   TIMB-METH

AKSE,AK ,TONF, ,

C0935

PERENSOVICH, M.M.

1966
BROWN BEAR STUDIES.

COMPLETION REP. 1960-1966. U.S.D.A., FOREST SERV., NORTH TONGASS
NATL. FOREST, JUNEAU, ALASKA. 38 PP.

POP DENS   HAB USE   MORT DATA   GARBAGE
HARV DATA   TIMB IMP   LITR SIZE   AGE/SEX
TIMB MGMT
AKSE,AK ,TONF, ,ADIS

00936

PERRY, J.L.

1977
PUBLIC OPINION ON GRIZZLY BEARS, NORTH FORK OF THE FLATHEAD STUDY
AREA.

PP. 99-102 IN: C. JONKEL, ED. ANNUAL REPORT NO. 2. BORDER GRIZZLY
PROJ., UNIV. MONT., MISSOULA.

PUBLIC ATT

NCDE,MT , , ,NFLT

C0937

PERRY, J.

1978
HANDLING CAPTURED BEARS: CAPTURE, DRUGGING, AND RADIO-COLLARING.

BORDER GRIZZLY TECH. COMM., BORDER GRIZZLY PROJ., UNIV. MONT., MI
SSOULA. WORKING PAP. NO. 31. 17 PP.

CAPTURE DRUGS

,GEN , , ,

C0938

PETERSON, R.L.

1965
A WELL-PRESERVED GRIZZLY BEAR SKULL RECOVERED FROM A LATE GLACIAL
DEPOSIT NEAR LAKE SIMCOE, ONTARIO.

NATURE 208(5016):1233-1234.

HIST DISTR

,ONT , , ,

C0939

PETKO-SEUS, P.A., B.C. HASTINGS, W.E. HAMMITT AND M.R. PELTON.

1985
PUBLIC ATTITUDES TOWARD COLLARS AND EAR MARKERS ON WILDLIFE.

WILDL. SOC. BULL. 13:283-286.

PUBLIC ATT GEN BIOL

,GEN , , ,

C0940

PHILLIPS, M.K.

1983
HABITAT USE AND BEHAVIOR OF GRIZZLY BEARS IN THE ARCTIC NATIONAL
WILDLIFE REFUGE.

ARCTIC NATL. WILDL. REFUGE PROG. REP. FY84-1: PP. 45-69 IN: G.W.
GARNER AND P.E. REYNOLDS, ED. 1983 UPDATE REPORT, BASELINE STUDY
OF THE FISH, WILDLIFE, AND THEIR HABITATS. U.S. FISH AND WILDL. S
ERV., ANCHORAGE.

FOOD HAB USE BEHAV PATT INTRASP BEH
PRED BRD AGE COURT

ARC ,AK ,ANWR, ,

00941

PHILLIPS, M.K.

1986
BEHAVIOR AND HABITAT USE OF GRIZZLY BEARS IN NORTHEASTERN ALASKA.

M.S. THESIS, UNIV. ALASKA, FAIRBANKS. 115 PP.

ACT PATT	COURT	BEHAV PATT	INTRASP BEH
FEED BEH	FOOD	CARCASS	PRED
HAB USE			

ARC ,AK ,ANWR, ,

00942

PHILLIPS, M.K.

IN PRESS
BEHAVIOR AND HABITAT USE OF GRIZZLY BEARS IN NORTHEASTERN ALASKA.

INT. CONF. BEAR RES. AND MANAGE. 7.

ACT PATT	BEHAV PATT	FOOD	HAB USE

ARC ,AK ,ANWR, ,

00943

PHILO, L.M., E.H. FOLLMANN AND H.V. REYNOLDS.

1981
FIELD SURGICAL TECHNIQUES FOR IMPLANTING TEMPERATURE-SENSITIVE RA DIO TRAN SMITTERS IN GRIZZLY BEARS.

J. WILDL. MANAGE. 45(3):772-775.

TELEM	TEMP

,GEN , , ,

00944

PICTON, H.D.

1975
AN ASSESSMENT OF THE PROBABLE GRIZZLY BEAR AMINO ACID AND PROTEIN REQUIREMENTS.

PREP. FOR INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 8 P P.

NUTR

,GEN , , ,

00945

PICTON, H.D.

1978
CLIMATE AND REPRODUCTION OF GRIZZLY BEARS IN YELLOWSTONE NATIONAL PARK.

NATURE 274(5674):888-889.

CLIMATE FOOD GARBAGE LITR SIZE

YGBE,IMW ,YNP , ,

00946

PICTON, H.D.

IN PRESS
GRIZZLY LINK? YELLOWSTONE AND GLACIER, ITS BIOLOGY AND DYNAMICS.

INT. CONF. BEAR RES. AND MANAGE. 6.

CLIMATE MOVE POP DENS POP EST
MGMT GEN

,MT , , ,

00947

PICTON, H.D. AND R.R. KNIGHT.

1961
BIG GAME SURVEYS AND INVESTIGATIONS. ELK AND BEAR SURVEYS.

FED. AID WILDL. REST. PROJ. NO. W-74-R-6, JOB A-1. JOB COMPLETION REP., MAY 1, 1960-APR. 30, 1961. MONT. FISH AND GAME DEP., HELENA. 38 PP.

HARV DATA

NCDE,MT ,SRGR, ,

00948

PICTON, H.D. AND R.R. KNIGHT.

1980
OBTAINING BIOLOGICAL INFORMATION FROM GRIZZLY BEAR (URSUS ARCTOS HORRIBILIS) HAIR.

PROC. NORTHWEST SECTION OF WILDL. SOC., APRIL 8-10, 1980, BANFF, ALBERTA. 20 PP.

HAIR AGE DETERM

,GEN , , ,

C0949

PICTON, H.D. AND R.R. KNIGHT.

IN PRESS
USING CLIMATE DATA TO PREDICT GRIZZLY BEAR LITTER SIZE.

INT. CONF. BEAR RES. AND MANAGE. 6.

CLIMATE LITR SIZE CARCASS

YGBE,IMW , , ,

C0950

PICTON, H.D., D.M. MATTSON, B.M. BLANCHARD AND R.R. KNIGHT.

1986
CLIMATE, CARRYING CAPACITY, AND THE YELLOWSTONE GRIZZLY BEAR.

PP. 129-135 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-G
RIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERVICE. INTERMOU
NTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

CLIMATE MOVE FOOD HAB USE
MGMT GEN MORT DATA HOME RNG

YGBE,IMW , , ,

00951

PICTON, J. AND P. ZAGER.

1985
WESTERN CABINET MOUTAINS GRIZZLY BEAR HABITAT SURVEY, 1985.

IDAHO FISH AND GAME, COEUR D'ALENE. 78 PP.

HIST DISTR PRES DISTR ROAD MGMT MGMT GEN
TYPE DESCRIP

CYE ,ID , , ,

00952

PIRTLE, R.B.

1979
A COMPILATION OF INCIDENTAL OBSERVATIONS OF BLACK AND BROWN BEAR
IN PRINCE WILLIAM SOUND, ALASKA.

ALASKA DEP. FISH AND GAME, DIV. COMMERICAL FISHERIES, PRINCE WILL
IAM SOUND MANAGE. AREA. DATA REP. NO. 12. 15 PP.

PRES DISTR CENSUS/TREND

AK-I,AK , , ,PRWM

C0953

POCOCK, R.I.

1914
ON THE FEET AND OTHER EXTERNAL FEATURES OF THE CANIDAE AND URSIDA
E.

PROC. ZOOL. SOC. LONDON 1914(PART III):913-341.

MORPH/PHYS

,GEN , , ,

C0954

POCOCK, R.I.

1928
THE STRUCTURE OF THE AUDITORY BULLA IN THE PROCYONIDAE AND THE UR
SIDAE, WITH A NOTE ON THE BULLA OF HYAENA.

PROC. ZOOL. SOC. LONDON 1928(PART IV):963-974.

MORPH/PHYS

,GEN , , ,

00955

POLACHECK, T.

1985
THE SAMPLING DISTRIBUTION OF AGE-SPECIFIC SURVIVAL ESTIMATES FROM
AN AGE DISTRIBUTION.

J. WILDL. MANAGE. 49(1):180-184.

AGE/SEX CENSUS METH

,GEN , , ,

00956

POST, K.L.

1982
HUMAN AND BEAR MOVEMENT, ACTIVITY AND INTERACTION AT PACK CREEK,
ALASKA.

M.S. THESIS, UNIV. IDAHO, MOSCOW. 174 PP.

NONMOT MGMT PUBLIC ATT HAB USE MOVE
BEHAV PATT REACTION ACT PATT NONMOTOR IMP

AKSE,AK ,AINM, ,PACR

00957

PRUITT, C.H. AND G.M. BURGHARDT.

1977
COMMUNICATION IN TERRESTRIAL CARNIVORES: MUSTELIDAE, PROCYONIDAE, AND URSIDAE.

PP. 767-793 IN: T.A. SEBEOK, ED. HOW ANIMALS COMMUNICATE. VOL. 2. INNDIANA UNIV. PRESS, BLOOMINGTON.

SMELL   BEHAV PATT   AGON   THREAT
INTRASP BEH   VOCAL   MARK   SIGHT

,GEN , , ,

00958

QUICK, R.

1969
HAND-REARING KODIAK BEARS.

INT. ZOO YEARB. 9:160-163.

GROW/DEV   ZOO TECH

,GEN , , ,

00959

QUIMBY, R.

1974
GRIZZLY BEAR.

CHAPTER II, 97 PP. IN: R.D. JAKIMCHUK, ED. MAMMAL STUDIES IN NORTHEASTERN ALASKA WITH EMPHASIS WITHIN THE CANNING RIVER DRAINAGE. ARCTIC GAS BIOL. REP. SER., VOL. 24.

POP BIOL   POP DENS   HAB USE   FOOD
CARCASS   MOVE   DEN   AIRCRAFT IMP

ARC ,AK , , ,EBRK

00960

QUIMBY, R. AND D.J. SNARSKI.

1974
A STUDY OF FUR-BEARING MAMMALS ASSOCIATED WITH GAS PIPLINE ROUTES IN ALASKA.

CHAPTER 2 IN: R.D. JAKIMCHUK, ED. DISTRIBUTION OF MOOSE, SHEEP, MUSKOX AND FURBEARING MAMMALS IN NORTHEASTERN ALASKA. ARCTIC GAS BIOL. REP. SER., VOL. 6.

PRES DISTR   POP DENS   CENSUS/TREND   AGE/SEX
PELAGE   MOVE   FOOD   DEN SITE

ARC ,AK , , ,EBRK

00961

RAINE, R.M. AND B.L. HOREJSI.

1984
AN INVESTIGATION OF THE DISTRIBUTION, MOVEMENTS, AND ACTIVITIES OF GRIZZLY BEARS IN THE SOUTH WAPITI REGION OF ALBERTA. PROG. REP. NO. 4, YEAR FOUR.

WESTERN WILDLIFE ENVIRONMENTS CONSULTING LTD., CALGARY. 81 PP.

PRES DISTR MOVE FOOD HAB USE

CR ,AT , , ,SWAP

00962

RAU, A.S.

1925
CONTRIBUTIONS TO OUR KNOWLEDGE OF THE STRUCTURE OF THE PLACENTA OF MUSTELIDAE, URSIDAE, AND SCIURIDAE.

PROC. ZOOL. SOC. LONDON 1925(PART III):1027-1069.

REPRO PHYS

,GEN , , ,

00963

RAUSCH, R.A.

1958
ALASKA PENINSULA BROWN BEAR STUDIES.

PP. 22-42 IN: ALASKA BROWN BEAR STUDIES. FED. AID WILDL. REST. PROJ. W-3-R-13, WORK PLAN J. JUNE 20, 1958- SEP. 1, 1958. ALASKA GAME COMMISSION, JUNEAU.

AGE/SEX CENSUS/TREND CENSUS METH LITR SIZE
REP RATE MORT RATE CANNIBAL HIST DISTR
POACH/ILLEG
AKPN,AK , , ,

00964

RAUSCH, R.A.

1972
APPENDIX XV. PREDATOR CONTROL AND BOUNTIES IN ALASKA (A 1971 REPORT TO THE COMMITTEE).

PAGES 173-182; IN: S.A. CAIN, CHAIRMAN. PREDATOR CONTROL - 1971. REPORT TO COUNCIL ON ENVIRON. QUALITY AND DEP. OF INTERIOR. ADVISORY COMMITTEE ON PREDATOR CONTROL. INSTIT. ENVIRON. QUALITY, UNIV. MICH., ANN ARBOR.

LEGAL CONTROL DEPRED

,AK , , ,

00965

RAUSCH, R.L.

1953
ON THE STATUS OF SOME ARCTIC MAMMALS.

ARCTIC 6:91-148.

MORPH/PHYS TAXON/EVOL SKULL DENT
PELAGE HIST DISTR

ARC ,AK , , ,

C0966

RAUSCH, R.L.

1963
GEOGRAPHIC VARIATION IN SIZE IN NORTH AMERICAN BROWN BEARS, URSUS ARCTOS L., AS INDICATED BY CONDYLOBASAL LENGTH.

CAN. J. ZOOL. 41:33-45.

SKULL TAXON/EVOL

,GEN , , ,

C0967

RAUSCH, R.L.

1969
MORPHOGENESIS AND AGE-RELATED STRUCTURE OF PERMANENT CANINE TEETH IN THE BROWN BEAR, URSUS ARCTOS L., IN ARCTIC ALASKA.

Z. MORPHOL. TIERE 66(2):167-188.

DENT SKULL AGE DETERM

ARC ,AK ,BROO, ,

00968

RAUSCH, R.L.

1973
RABIES IN ALASKA, PREVENTION AND CONTROL.

U.S. DEPT. HEALTH, EDUCATION AND WELFARE, ARCTIC HEALTH RESEARCH CENTER, FAIRBANKS.

PARAS/DIS

,AK , , ,

C0969

REID, M.M. AND S.D. GEHMAN.

1986
A COMMON SENSE APPROACH TO GRIZZLY BEAR HABITAT EVALUATION.

PP. 92-98 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

HAB RECON HAB SAMPL RES TECH RECR IMP
MGMT GEN

YGBE,IMW , , ,

C0970

REID, M., R. MULE AND B. RENFROW.

1983
ASSESSMENT OF GRIZZLY BEAR UTILIZATION AND HABITAT QUALITY IN THE CLARKS FORK SNOWMOBILE TRAIL CORRIDOR.

PREP. FOR DOUGLAS HART B-4 RANCH. PREP. BY KRA NAT. RESOUR. CONSULTANTS, BOZEMAN, MONT. 54 PP.

HAB RECON MOTOR IMP PRES DISTR

YGBE,WY ,SHNF, ,

00971

REIGER, I.

1972
SCENT RUBBING IN CARNIVORES.

CARNIVORE 2(1):17-25.

MARK TERR/SPACE

,GEN , , ,

C0972

REINECKE, K.J. AND R.B. OWEN.

1980
FOOD USE AND NUTRITION OF BLACK DUCKS NESTING IN MAINE.

J. WILD. MANAGE. 44(3):549-555.

FOOD

,GEN , , ,

00973

REINHART, D. AND D. MATTSON.

1986
YELLOWSTONE LAKE TRIBUTARY STUDY.

PP. 52-66. IN: R.R. KNIGHT, B.M. BLANCHARD AND D. MATTSON, EDS., YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS ANNUAL REPORT OF THE INTERAGENCY STUDY TEAM, 1985. U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT
PRED HAB USE

YGBE,WY ,YNP , ,LAKE

00974

REMINGTON, J.D.

1955
EXTENT OF BEAR RANGE IN COLORADO.

COLO. DIV. OF WILDL., DENVER. 15 PP.

HIST DISTR

,CO , , ,

00975

RETFALVI, L.I.

1975
FOOD OF GRIZZLY BEARS IN BANFF NATIONAL PARK, 1972-73.

CAN. WILDL. SERV. 31 PP.

FOOD

CR ,AT ,BANP, ,

00976

REVENTLOW, A.

1954
THE KODIAK BEAR CUB "URSULA."

ZOOL. GART. 20(4-5):279-282.

ZOO TECH

,GEN , , ,

C0977

REVUSKY, S. AND E.W. BEDARF.

1967
ASSOCIATION OF ILLNESS WITH INGESTION OF NOVEL FOOD.

SCIENCE 155:219-220.

AVER COND

,GEN , , ,

00978

REYNOLDS, H.V.

1975
BIG GAME INVESTIGATIONS. MOVEMENTS AND POPULATION DISCRETENESS OF NORTH SLOPE GRIZZLY BEARS. COMPARISON OF CENSUSING TECHNIQUES OF NORTH SLOPE GRIZZLY BEARS. FOOD HABITS OF NORTH SLOPE GRIZZLY BEARS.
FED. AID WILDL. REST. PROJ. W-17-6, JOB NOS. 4.8R, 4.10R AND 4.11R. JOB PROG. REP., JULY 1, 1973-JUNE 30, 1974. ALASKA DEP. FISH AND GAME, JUNEAU. 26 PP.

AGE/SEX	MEAS/QUANT	REP RATE	AGON
CENSUS METH	FOOD	MOVE	

ARC ,AK , , ,EBRK

00979

REYNOLDS, H.V.

1976
BIG GAME INVESTIGATIONS. MOVEMENTS AND POPULATION DISCRETENESS OF NORTH SLOPE GRIZZLY BEARS. COMPARISON OF CENSUSING TECHNIQUES OF NORTH SLOPE GRIZZLY BEARS. FOOD HABITS OF NORTH SLOPE GRIZZLY BEARS.
FED. AID WILDL. REST. PROJ. W-17-6, JOB NOS. 4.8R, 4.10R AND 4.11R. FINAL REP., JULY 1, 1973-JUNE 30, 1975. ALASKA DEP. FISH AND GAME, JUNEAU. 21 PP.

AGE/SEX	REP RATE	CENSUS METH	MOVE
HOME RNG	FOOD	MEAS/QUANT	

ARC ,AK , , ,EBRK

C0980

REYNOLDS, H.V.

1978
STRUCTURE, STATUS, REPRODUCTIVE BIOLOGY, MOVEMENT, DISTRIBUTION AND HABITAT UTILIZATION OF A GRIZZLY BEAR POPULATION IN NPR-A.

FED. AID WILDL. REST. PROJ., 105C STUDIES, WORK GROUP NO. 3. FINAL REP. APR. 1, 1977-SEP. 30, 1978. 61 PP.

GEN DATA	POP EST	POP DENS	CENSUS METH
AGE/SEX	REP RATE	MORT RATE	CARCASS
DEN			

ARC ,AK ,NPR , ,WBRK

00981

REYNOLDS, H.V.

1980
BIG GAME INVESTIGATIONS. CHARACTERISTICS OF GRIZZLY BEAR PREDATIO
N ON CARIBOU IN THE CALVING GROUNDS OF THE WESTERN ARCTIC HERD.

FED AID WILDL. REST. PROJ. W-21-2, JOB 4.16R. JOB PROG.REP., JULY
L, 1978-JUNE 30, 1979. ALASKA DEP. FISH AND GAME, JUNEAU. 12 PP.

PRED POP DENS CARCASS FEED BEH

ARC ,AK , , ,BRKR

00982

REYNOLDS, H.V.

1981
NORTH SLOPE GRIZZLY BEAR STUDIES.

FED. AID WILDL. REST. PROJ. W-21-1, JOB 4.14R. JOB PROG. REP., VO
L. II. ALASKA DEP. FISH AND GAME, JUNEAU. 27 PP.

POP EST POP DENS AGE/SEX REP RATE
MORT DATA MOVE HOME RNG MEAS/QUANT

ARC ,AK , , ,WBRK

00983

REYNOLDS, H.V.

1982
ALASKA RANGE GRIZZLY BEAR STUDIES.

FED. AID WILDL. REST. PROJ. W-21-2, JOB 4.16R. PROJ. PROG. REP.,
VOL. I. ALASKA DEP. FISH AND GAME, JUNEAU. 12 PP.

POP DENS HARV DATA

AK-I,AK , , ,AKRG

00984

REYNOLDS, H.V.

1984
GRIZZLY BEAR POPULATION BIOLOGY IN THE WESTERN BROOKS RANGE, ALAS
KA.

APP. A, PP. 2-19 IN: H.V. REYNOLDS AND J.L. HECHTEL,EDS.,STRUCTUR
E, STATUS, REPRODUCTIVE BIOLOGY, MOVEMENT, DISTRIBUTION, AND HABI
TAT UTILIZATION OF A GRIZZLY BEAR POPULATION. FED. AID WILDL. RES
T. PROJ. FINAL REP.

POP DENS POP EST AGE/SEX MORT RATE
BRD AGE LITR SIZE LITR FREQ CANNIBAL

ARC ,AK , ,WBRK,BRKR

00985

REYNOLDS, H.V., J.A. CURATOLO AND R. QUIMBY.

1976
DENNING ECOLOGY OF GRIZZLY BEARS IN NORTHEASTERN ALASKA.

INT. CONF. BEAR RES. AND MANAGE. 3:403-409.

DEN SITE DEN CHAR DEN CHRON

ARC ,AK , , ,EBRK

00986

REYNOLDS, H.V. AND J.L. HECHTEL.

1980
BIG GAME INVESTIGATIONS. STRUCTURE, STATUS, REPRODUCTIVE BIOLOGY, MOVEMENTS, DISTRIBUTION AND HABITAT UTILIZATION OF A GRIZZLY BEA R POPULATION.

FED. AID WILDL. REST. PROJ. W-17-11, JOB 4.14R. JOB PROG. REP., J ULY 1, 1978-JUNE 20, 1979. ALASKA DEP. FISH AND GAME, JUNEAU. 66 PP.

GEN DATA MEAS/QUANT POP REG POP BIOL
ENERGY IMP AGON PCP DENS DEN
POP EST
ARC ,AK ,NPR , ,WBRK

00987

REYNOLDS, H.V. AND J. HECHTEL.

1982
NORTH SLOPE GRIZZLY BEAR STUDIES.

FED. AID WILDL. REST. PROJ. W-21-2, JOB 4. 14R. JOB PROG. REP., V OL. III. JULY 1, 1980-JUNE 30, 1981. ALASKA DEP. FISH AND GAME, J UNEAU. 19 PP.

REP RATE MORT DATA MORT RATE AGE/SEX
WEIGHT MOVE

ARC ,AK , , ,WBRK

00988

REYNOLDS, H.V. AND J.L. HECHTEL.

1983A
POPULATION STRUCTURE, REPRODUCTIVE BIOLOGY, AND MOVEMENT PATTERNS OF GRIZZLY BEARS IN THE NORTHCENTRAL ALASKA.

FED. AID WILDL. REST. PROJ. W-22-1, JOB 4.16R. PROG. REP., VOL. I I. JULY 1, 1981 - JUNE 30, 1982. ALASKA DEP. FISH AND GAME, JUNE AU. 29 PP.

POP DENS AGE/SEX BRD AGE LITR FREQ
LITR SIZE MOVE HOME RNG MEAS/QUANT

AK-I,AK , , ,AKRG

C0989

REYNOLDS, H.V. AND J.L. HECHTEL.

1983B
STRUCTURE, STATUS, REPRODUCTIVE BIOLOGY, MOVEMENT, DISTRIBUTION, AND HABITAT UTILIZATION OF A GRIZZLY BEAR POPULATION.

FED. AID WILDL. REST. PROJ. W-22-1, JOB 4.14R. PROG. REP., VOL. I V. ALASKA DEP. FISH AND GAME, JUNEAU. 24 PP.

REP RATE	MORT DATA	DEN CHRON	MOVE
HOME RNG	AGE/SEX	WEIGHT	

ARC ,AK , , ,WBRK

C0990

REYNOLDS, H.V. AND J.L. HECHTEL.

1984A
POPULATION STRUCTURE, REPRODUCTIVE BIOLOGY, AND MOVEMENT PATTERNS OF GRIZZLY BEARS IN THE NORTHCENTRAL ALASKA RANGE.

FED. AID WILDL. REST. PROJ. W-22-2, JOB 4.16R. PROG. REP., JULY 1, 1982- JUNE 30, 1983. ALASKA DEPT. FISH AND GAME, JUNEAU. 30 PP.

POP DENS	AGE/SEX	REP RATE	MORT DATA
MOVE	HOME RNG	DEN	WEIGHT

AK-I,AK , , ,AKRG

C0991

REYNOLDS, H.V. AND J.L. HECHTEL.

1984B
STRUCTURE, STATUS, REPRODUCTIVE BIOLOGY, MOVEMENT, DISTRIBUTION, AND HABITAT UTILIZATION OF A GRIZZLY BEAR POPULATION.

FED. AID WILDL. REST. PROJ. W-21-1, W-21-2, W-22-1, W-22-2, JOB 4.14R. FINAL REP,. JULY 1, 1979- JUNE 30, 1983. ALASKA DEP. FISH AND GAME, JUNEAU. 29 PP.

POP DENS	POP EST	AGE/SEX	MORT RATE
BRD AGE	LITR SIZE	LITR FREQ	CANNIBAL
WEIGHT			

ARC ,AK , , ,WBRK

C0992

REYNOLDS, P., H.V. REYNOLDS AND E.H. FOLLMANN.

IN PRESS
EFFECTS OF SEISMIC SURVEYS ON DENNING GRIZZLY BEARS IN NORTHERN ALASKA.

INT. CONF. BEAR RES. AND MANAGE. 6.

HEART	ENERGY IMP	AIRCRAFT IMP	ENERGY MGMT

ARC ,AK ,NPR , ,BRKR

C0993

RIDLEY, J.

1976
BEAR-HUMAN MANAGEMENT AT THE PROPOSED KANANASKIS PROVINCIAL PARK (DRAFT).

ALBERTA RECREATION PARKS AND WILDL. 30 PP.

EDUC GARB MGMT DETER/REPEL NONMOT MGMT
CLOSURE

CR ,AT ,KANP, ,

C0994

RIEGELHUTH, R.

1966
GRIZZLY BEARS AND HUMAN VISITATION.

M.S. THESIS, COLO. STATE UNIV., FT. COLLINS, 80 PP.

RECR IMP

,GEN , , ,

C0995

RIGGS, R.A.

1979
AN ALTERNATIVE MANAGEMENT DESIGN FOR REDUCING HUMAN/BEAR CONFLICTS IN THE CAMAS CREEK DRAINAGE.

U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 14 PP.

CAMP MGMT NONMOT MGMT

NCDE,MT ,GLNP, ,CAMA

C0996

RIGGS, R.A. AND C. ARMOUR.

1981
A HYPOTHESIS FOR PREDICTING GRIZZLY BEAR HABITAT USE IN SPRING FLOODPLAIN HABITAT MOSAICS WITH SPECIAL REFERENCE TO REDUCING HUMAN-BEAR CONTACT RATES.

U.S.D.I., NATL. PARK SERV., GLACIER NATL. PARK, MONT. 28 PP.

HAB USE MOVE

NCDE,MT ,GLNP, ,

00997

ROBERGE, A. AND R. CHARBONNEAU.

1971
ACTIVITIES OF UREA CYCLE ENZYMES IN LIVER OF BROWN BEARS.

COMP. BIOCHEM. PHYSIOL. 38(B):295-298.

MORPH/PHYS

,GEN , , ,

00998

ROBINSON, R.

1972
HYBRIDIZATION AMONG THE URSIDAE.

CARNIVORE GENETICS NEWSL. 2(3):61-63.

GENETICS

,GEN , , ,

00999

ROCKWELL, S.K., J.L. PERRY, M. HAROLDSON AND C. JONKEL.

1978
VEGETATION STUDIES OF DISTURBED GRIZZLY HABITAT.

PP. 17-68 IN: C. JONKEL, ED. ANN. REP. NO. 3. BORDER GRIZZLY PROJ
., UNIV. MONT., MISSOULA.

HOME RNG HAB USE MEAS/QUANT HAB EFFECT
AGE/SEX DEN SITE

NCDE,MT , , ,NFLT

01000

ROGERS, L.L.

1976
EFFECTS OF MAST AND BERRY CROP FAILTURES ON SURVIVAL, GROWTH AND
REPRODUCTIVE SUCCESS FOR BLACK BEARS.

PROC. NORTH AM. WILDL. AND NAT. RESOUR. CONF. 41:431-438.

POP REG FOOD NUTR REPRO PHYS
GARBAGE PELAGE

,GEN , , ,

01001

ROGERS, L.L.

1978
EFFECTS OF FOOD SUPPLY, PREDATION, CANNIBALISM, PARASITES, AND OT
HER HEALTH PROBLEMS ON BLACK BEAR POPULATIONS.

PP. 194-211 IN: F.L. BUNNELL, D.S. EASTMAN AND J.M. PEEK, EDS. SY
MP. ON NAT. REGULATION OF WILDL. POPULATIONS, 10 MARCH 1978, VANC
CUVER, B.C.

NUTR FOOD WEIGHT REPRO PHYS
GROW/DEV AGON TERR/SPACE CANNIBAL
POP REG
,GEN , , ,

01002

ROGERS, L.L.

1980
INHERITANCE OF COAT COLOR AND CHANGES IN PELAGE COLORATION IN BLA
CK BEARS IN NORTHEASTERN MINNESOTA.

J. MAMMAL. 61(2):324-327.

PELAGE

,GEN , , ,

01003

ROGERS, L.L.

1984
REACTIONS OF FREE-RANGING BLACK BEARS TO CAPCAICIN SPRAY REPELLEN
T.

WILDL. SOC. BULL. 12:59-61.

DETER/REPEL

,GEN , , ,

01004

ROGERS, L.

1986
EFFECTS OF TRANSLOCATION DISTANCE ON FREQUENCY OF RETURN BY ADULT
BLACK BEARS.

WILDL. SOC. BULL. 14:76-80.

RELOC

,GEN , , ,

01005

ROGERS, L., D. KUEHN, A. ERICKSON, E. HARGER, L. VERME AND J. OZOGA
.
1976
CHARACTERISTICS AND MANAGEMENT OF BLACK BEARS THAT FEED IN GARBAG
E DUMPS, CAMPGROUNDS OR RESIDENTIAL AREAS.

INT. CONF. BEAR RES. AND MANAGE. 3:169-175.

GARBAGE WEIGHT

,GEN , , ,

01006

ROGERS, L.L. AND S.M. ROGERS.

1976
PARASITES OF BEARS: A REVIEW.

INT. CONF. BEAR RES. AND MANAGE, 3:411-430.

PARAS/DIS

,GEN , , ,

01007

ROGERS, L.L., C.M. STOWE AND A.W. ERICKSON.

1976
SUCCINYLCHOLINE CHLORIDE IMMOBILIZATION OF BLACK BEARS.

INT. CONF. BEAR RES. AND MANAGE. 3:431-446.

DRUGS

,GEN , , ,

01008

ROGNURD, M.

1956
GRIZZLY BEAR SURVEY.

FED. AID WILDL. REST. PROJ. W-71-R, W-72-R, W-74-R, JOB A-7. JOB
COMPLETION REP., FALL AND SPRING 1955 AND 1956. MONT. FISH AND GA
ME DEP., HELENA. 9 PP.

HARV DATA AGE/SEX CENSUS/TREND LITR SIZE

,MT , , ,

01009

ROOP, L.

1975
GRIZZLY BEAR STUDY.

FED. AID WILDL. REST. PROJ. W-87-R-1, JOB NOS. 1, 2, AND 3. PROG. REP. WYO. GAME AND FISH DEP., GAME DIV., LARAMIE. 60 PP.

PRES DISTR	CENSUS METH	MORT DATA	HARV DATA
AGE/SEX	LITR SIZE	MOVE	FOOD

YGBE,WY ,SHNF,BTNF,

01010

ROOP, L.

1976
GRIZZLY BEAR STUDY.

FED. AID WILDL. REST. PROJ. W-87-R-2, JOB NOS. 1, 2 AND 3. PROG. REP. WYO. GAME AND FISH DEP., GAME DIV., LARAMIE. 64 PP.

PRES DISTR	HAB USE	CENSUS METH	MORT DATA
HARV DATA	AGE/SEX	LITR SIZE	MOVE
HOME RNG			

YGBE,MT ,BTNF,SHNF,

01011

ROOP, L.

1977
GRIZZLY BEAR.

FED. AID WILDL. REST. PROJ. W-87-R-2, JOB NOS. 1, 2 AND 3. PROG. REP. WYO. GAME AND FISH DEP., GAME DIV., LARAMIE. 47 PP.

PRES DISTR	CENSUS METH	DEPRED	MORT DATA
POACH/ILLEG	RES MORT	MOVE	HOME RNG

YGBE,MT ,SHNF,BTNF,

01012

ROOP, L.

1978
GRIZZLY BEAR.

FED. AID WILDL. REST. PROJ. W-27-R-30, JOB NOS. 1 AND 2. PROG. REP. WYO. GAME AND FISH DEP., GAME DIV., LARAMIE. 61 PP.

DEPRED	NONMOTOR IMP	MORT DATA	HOME RNG
MOVE	AGE/SEX	ORPHAN	PRES DISTR

YGBE,WY ,SHNF,BTNF,

01013

ROOP, L.

1979
GRIZZLY BEAR.

FED. AID WILDL. REST. PROJ. W-27-R-30, JOB NOS. 1, 2 AND 3. PROG. REP. WYO. GAME AND FISH DEP., GAME DIV., LARAMIE. 26 PP.

PRES DISTR DEPRED MORT DATA WEIGHT

YGBE,WY ,SHNF,BTNF,

01014

ROOP, L.

1980A
GRIZZLY BEAR.

FED. AID. WILDL. REST. PROJ. W-27-R-30, JOB NOS. 1, 2 AND 3. PROG . REP. WYO. GAME AND FISH DEP., GAME DIV., LARAMIE, 36 PP.

PRES DISTR COPULATE NCNMOTOR IMP MORT DATA
AGON LITR SIZE AGE/SEX HOME RNG

YGBE,WY ,BTNF,SHNF,

01015

ROOP, L.

1980B
THE YELLOWSTONE GRIZZLY BEAR: A REVIEW OF PAST AND PRESENT POPULA TION ESTIMATES.

PP. 61-75 IN: R.R. KNIGHT, B.M. BLANCHARD, K.C. KENDALL AND L.E. OLDENBURG, EDS. YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS. ANNUAL R EPORT OF THE INTERAGENCY STUDY TEAM, 1978 AND 1979. BOZEMAN, MONT .

CENSUS METH POP EST MORT DATA DEMOG ANAL

YGBE,IMW , , ,

01016

ROOP, L.

1981
GRIZZLY BEAR.

FED. AID WILDL. REST. PROJ. W-27-R-30,JOB NOS. 1, 2 AND 3. PROG. REP. WYO. GAME AND FISH DEP., GAME DIV., LARAMIE. 33 PP.

PRES DISTR PUBLIC ATT NONMOTOR IMP POACH/ILLEG
MORT DATA DEPRED LITR SIZE AGE/SEX
WEIGHT

NCDE,WY ,SHNF,BTNF,

01017

ROOP, L.

1982
GRIZZLY BEAR.

FED. AID WILDL. REST. PROJ. W-27-R-30, JOB NOS. 1, 2 AND 3. PROG. REP. WYO. GAME AND FISH DEP., GAME DIV., LARAMIE. 67 PP.

CLIMATE PRES DISTR MORT DATA POACH/ILLEG
RELOC NONMOTOR IMP AGE/SEX WEIGHT
HOME RNG
YGBE,WY ,SHNF,BTNF,

01018

ROOP, L.

1983
GRIZZLY BEAR.

FED. AID WILDL. REST. PROJ. SE-1-1, JOB NOS. 1, 2 AND 3. PROG. REP. 1982 FIELD SEASON. WYO. GAME AND FISH DEP., GAME DIV., LARAMIE. 59 PP.

PRES DISTR RELOC POACH/ILLEG MORT DATA
AGE/SEX WEIGHT MOTOR IMP NONMOTOR IMP
RES MORT
YGBE,WY ,SHNF,BTNF,

01019

ROTH, H.U.

1980
DEFECATION RATES OF CAPTIVE BROWN BEARS.

INT. CONF. BEAR RES. AND MANAGE. 4:249-253.

DIGEST

,GEN , , ,

01020

ROTH, H.U.

1983
DIEL ACTIVITY OF A REMNANT POPULATION OF EUROPEAN BROWN BEARS.

INT. CONF. BEAR RES. AND MANAGE. 5:223-229.

ACT PATT

,GEN , , ,

01021

ROTHWEILER, R.A.

1964
BIG GAME SURVEYS AND INVESTIGATIONS - ANTELOPE, BIGHORN SHEEP, MO
UNTAIN GOATS AND BEAR.

FED. AID WILDL. REST. PROJ. W-74-R-9, JOB A-1. JOB COMPLETION REP
., MAY 1, 1963-APR. 30, 1964. MONT. FISH AND GAME DEP., HELENA. 9
PP.

HARV DATA

NCDE,MT , , ,

01022

RUEDIGER, W. AND S. MEALEY.

1978
COORDINATION GUIDELINES FOR TIMBER HARVESTING IN GRIZZLY BEAR HAB
ITAT IN NORTHWESTERN MONTANA.

U.S.D.A., FOREST SERV., KOOTENAI NATL. FOREST, MONT. AND SHOSHONE
NATL. FOREST, WYO. 44 PP.

ROAD IMP ROAD MGMT TIMB IMP TIMB MGMT
TIMB-METH TIMB-POST COVER HAB USE

YGBE,WY ,SHNF, ,

01023

RUSSELL, A.

1967
GRIZZLY COUNTRY.

JARROLDS PUBLISHERS LTD., LONDON. 302 PP.

HIST ACCT

,GEN , , ,

01024

RUSSELL, D.

1974
GRIZZLY BEAR MOUNTAIN GOAT INVESTIGATIONS IN KNIGHT INLET, B.C.,
SUMMER 1974.

PROJ. REP. B.C. FISH AND WILDL. BRANCH, VICTORIA. 84 PP.

CENSUS METH CENSUS/TREND MOVE TIMB IMP
FOOD HAB USE TIMB-HAB

BC-C,BC , , ,AHNU

C1025

RUSSELL, R.H., J.W. NOLAN, N.G. WOODY AND G.H. ANDERSON.

1979
A STUDY OF THE GRIZZLY BEAR IN JASPER NATIONAL PARK, 1975 TO 1978
.

PREP. FOR PARKS CANADA. PREP. BY CAN. WILDL. SERV., EDMONTCN. 136
PP.

GEN DATA	MEAS/QUANT	AGE/SEX	ORPHAN
POP BIOL	POP DENS	NCNMOT MGMT	DEN
COURT			

CR ,AT ,JANP, ,

01026

RUSSELL, R.H., J.W. NOLAN, N.G. WOODY, G.H. ANDERSON AND A.M. PEARS
CN.
1978
A STUDY OF THE GRIZZLY BEAR (URSUS ARCTOS) IN JASPER NATICNAL PAR
K: A PROGRESS REPORT 1976 AND 1977.

PREP. FOR PARKS CANADA. PREP. BY CAN. WILDL. SERVICE, EDMONTON, A
LBERTA. 95 PP.

GEN DATA	DEN	WEIGHT	BRD AGE
AGE/SEX	ORPHAN	NCNMOT MGMT	PELAGE
POP DENS			

CR ,AT ,JANP, ,

01027

RUSSELL, W.C.

1970
HYPOTHYROIDISM IN A GRIZZLY BEAR.

J. AM. VET. MED. ASSOC. 157(5):656-662.

PARAS/DIS	NUTR

,GEN , , ,

01028

RUTTAN, R.A.

1974
CBSERVATIONS OF GRIZZLY BEAR IN THE NORTHERN YUKON TERRITORY AND
MACKENZIE RIVER VALLEY, 1972.

CHAPTER VII IN: R.A. RUTTAN AND D.R. WOOLEY, EDS. STUDIES CF FURB
EARERS ASSOCIATED WITH PROPOSED PIPELINE ROUTES IN THE YUKON AND
NORTHWEST TERRITORIES. ARCTIC GAS BICL. REP. SER. VOL. 9.

PRES DISTR	MOVE	AGE/SEX	DEN
PELAGE	FOOD	PRED	INTERSP COMP
AIRCRAFT IMP			

CARC,YK , , ,

01029

SALWASSER, H.

1983
WILDLIFE POPULATION VIABILITY: A QUESTION OF RISK.

TRANS NORTH AM. WILDL. AND NAT. RESOUR CONF. 49:421-439.

MGMT GEN GENETICS

,GEN , , ,

01030

SALWASSER, H. AND F.B. SAMSON.

1985
CUMULATIVE EFFECTS ANALYSIS: AN ADVANCE IN WILDLIFE PLANNING AND MANAGEMENT.

PRES. AT 50TH N. AM. WILDL. NAT. RES. CONF., WASHINGTON, D.C. 14 PP.

CUM EFF

,GEN , , ,

01031

SAMSON, F.B.

1983
MINIMUM VIABLE POPULATIONS - A REVIEW.

NATURAL AREAS JOURNAL 3(3):15-23.

MIN POP GENETICS

,GEN , , ,

01032

SAMSON, F.B., F. PEREZ-TREJO, H. SALWASSER, L.F. RUGGIERO AND M.L. SHAFFER.
1985
ON DETERMINING AND MANAGING MINIMUM POPULATION SIZE.

WILDL. SOC. BULL. 13:425-433.

MIN POP

,GEN , , ,

01033

SAMUEL, M.D. AND E.O. GARTON.

1985
HOME RANGE: A WEIGHTED NORMAL ESTIMATE AND TESTS OF UNDERLYING AS
SUMPTIONS.

J. WILDL. MANAGE. 49(2):513-519.

HOME RNG

,GEN , , ,

01034

SCAGGS, G.B.

1979
VEGETATION DESCRIPTION OF POTENTIAL GRIZZLY BEAR HABITAT IN THE S
ELWAY-BITTERROOT WILDERNESS AREA, MONTANA AND IDAHO.

M.S. THESIS, UNIV. MONTANA, MISSOULA, 148 PP.

HAB EFFECT

SBE ,IDMT,BINF,NPNF,SBWA

01035

SCHALLENBERGER, A.

1974
RECONNAISSANCE SURVEY OF GRIZZLY BEAR HABITAT, ROCKY MOUNTAIN DIV
ISION, LEWIS AND CLARK NATIONAL FOREST.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. 14 PP + APP.

HAB RECON HAB USE PRES DISTR

NCDE,MT ,LCNF, ,

01036

SCHALLENBERGER, A.

1976
GRIZZLY BEAR HABITAT SURVEY. BADGER CREEK-SOUTH FORK TWO MEDICINE
MANAGEMENT UNIT, LEWIS AND CLARK NATIONAL FOREST.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. 21 PP + APP.

HAB EFFECT LIVESTK IMP PRES DISTR HAB USE
POP DENS CAMP MGMT MOVE

NCDE,MT ,LCNF, ,BACR

01037

SCHALLENBERGER, A.

1980
REVIEW OF OIL AND GAS EXPLOITATION IMPACTS ON GRIZZLY BEARS.

INT. CONF. BEAR RES. AND MANAGE. 4:271-276.

ENERGY IMP HUMAN IMP

NCDE,MT , , ,

01038

SCHALLENBERGER, A. AND C. JONKEL.

1978A
CRITIQUE OF THE U.S.F.S. ROCKY MOUNTAIN FRONT PLAN.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 12. 2
5 PP.

ROAD IMP ROAD MGMT FIRE MGMT MGMT GEN

NCDE,MT ,USFS,BLM ,RMEF

01039

SCHALLENBERGER, A. AND C.J. JONKEL.

1978B
ROCKY MOUNTAIN EAST FRONT GRIZZLY STUDIES, 1977.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 18. 6
9 PP.

MOVE HOME RNG HAB USE FOOD
MEAS/QUANT DEN SITE

NCDE,MT ,USFS,BLM ,RMEF

C1040

SCHALLENBERGER, A. AND C.J. JONKEL.

1979A
ROCKY MOUNTAIN EAST FRONT GRIZZLY STUDIES, 1978.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 27. 1
15 PP.

HUMAN IMP MEAS/QUANT AGE/SEX TYPE DESCRIP
MOVE FOOD HAB USE HOME RNG

NCDE,MT ,USFS,BLM ,RMEF

01041

SCHALLENBERGER, A. AND C. JONKEL.

1979B
ANTELOPE BUTTE-MUDDY CREEK GRIZZLY BEAR HABITAT.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 35. 2
0 PP.

HAB USE	PRES DISTR	RECR IMP	LIVESTK IMP
HUMAN IMP	ROAD IMP	MGMT GEN	

NCDE,MT , , ,ANBU

01042

SCHALLENBERGER, A. AND C. JONKEL.

1980
ROCKY MOUNTAIN EAST FRONT GRIZZLY STUDIES, 1979.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 39. 2
07 PP.

GEN DATA	MEAS/QUANT	DEN	ROAD IMP
RECR IMP	LIVESTK IMP	MGMT GEN	HUMAN IMP
TYPE DESCRIP			

NCDE,MT ,USFS,BLM ,RMEF

01043

SCHERREN, H.

1907
SOME NOTES ON HYBRID BEARS.

PROC. ZOOL. SOC. LONDON 1(MARCH/APRIL):431-435.

GENETICS	ZOO TECH

,GEN , , ,

01044

SCHLEYER, B.O.

1980
DAILY ROUTINE OF GRIZZLY BEARS IN THE YELLOWSTONE SYSTEM.

PP. 35-41 IN: R.R. KNIGHT, B.M. BLANCHARD, K.C. KENDALL AND L.E.
OLDENBURG, EDS. YELLOWSTONE GRIZZLY BEAR INVESTIGATIONS. U.S.D.I.
, INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 91 PP.

ACT PATT	DAY BED	REACTION	AIRCRAFT IMP
	MATERNAL	MOVE	HOME RNG

YGBE,IMW , , ,

01045

SCHLEYER, B.O.

1983
ACTIVITY PATTERNS OF GRIZZLY BEARS IN THE YELLOWSTONE ECOSYSTEM A
ND THEIR REPRODUCTIVE BEHAVIOR, PREDATION AND THE USE OF CARRION.

M.S. THESIS, MONT. STATE UNIV., BOZEMAN. 130 PP.

ACT PATT BEHAV PATT PRED AGON
FEED BEH NOCT BEH DIUR BEH REACTION
COURT
YGBE,IMW , , ,

01046

SCHLEYER, B.O., J.J. JONKEL, K.G. RHOADES AND D.M. DUNBAR.

1984
THE EFFECTS OF NONMOTORIZED RECREATION ON GRIZZLY BEAR BEHAVIOR A
ND HABITAT USE.

U.S.D.I., INTERAGENCY GRIZZLY BEAR STUDY TEAM, BOZEMAN, MONT. 83
PP.

NONMOTOR IMP REACTION HUMAN INJ COVER
HAB USE TIMB USE ACT PATT

YGBE,IMW , , ,

01047

SCHMIDT, D.R.

1982
A BROWN BEAR (URSUS ARCTOS) - HUMAN ENCOUNTER IN THE BROOKS RANGE
, ALASKA.

CAN. FIELD-NAT. 96(3):347.

REACTION

ARC ,AK , , ,BRKR

01048

SCHNOES, R. AND E. STARKEY.

1978
BEAR MANAGMENT IN THE NATIONAL PARK SYSTEM.

OREGON COOP. PARK STUDIES UNIT, OREGON STATE UNIV., CORVALLIS.

RECR MGMT MGMT GEN GARB MGMT

,US , , ,

01049

SCHOEN, J.

1982
BROWN BEAR HABITAT PREFERENCES AND BROWN BEAR LOGGING AND MINING RELATIONSHIPS IN SOUTHEAST ALASKA.

FED. AID WILDL. REST. PROJ. W-22-1, JOB 4-17R. PROG. REP., VOL. I ., SEP. 29, 1981-JUNE 30, 1982. ALASKA DEP. FISH AND GAME, JUNEAU . 44 PP.

RES MORT	AGE/SEX	WEIGHT	DEN SITE
DRUGS	DEN CHRON		

AKSE,AK , , ,ADIS

01050

SCHOEN, J.

1986
REVIEW OF POPULATION STATUS, FORESTRY RELATIONSHIPS, AND PREDATOR MANAGEMENT OF BROWN/GRIZZLY BEARS IN NORTH AMERICA.

PP. 31-43. IN: J.W. SCHOEN AND L. BEIER, BROWN BEAR HABITAT PREFERENCES AND BROWN BEAR LOGGING AND MINING RELATIONSHIPS IN SOUTHEAST ALASKA. FED. AID WILDL. REST. PROJ. ALASKA DEP. FISH AND GAME, JUNEAU.

PRES DISTR	POP EST	TIMB IMP	ROAD IMP
TIMB-HAB	TIMB-METH	TIMB-ENTRY	ROAD MGMT
HARV MGMT			

,GEN , , ,

01051

SCHOEN, J.W. AND L.R. BEIER.

1983
BROWN BEAR HABITAT PREFERENCES AND BROWN BEAR LOGGING AND MINING RELATIONSHIPS IN SOUTHEAST ALASKA.

FED. AID WILDL. REST. PROJ. W-22-2, JOB 4-17R. PROG. REP., VOL II ., JULY 1, 1982-JUNE 30, 1983. ALASKA DEP. FISH AND GAME, JUNEAU. 39 PP.

HOME RNG	DEN CHRON	DEN SITE	AGE/SEX
WEIGHT	PRES DISTR	HAB USE	

AKSE,AK , , ,ADIS

01052

SCHOEN, J.W. AND L. BEIER.

1985
BROWN BEAR HABITAT PREFERENCES AND BROWN BEAR LOGGING AND MINING RELATIONSHIPS IN SOUTHEAST ALASKA.

FED. AID WILDL. REST. PROJ. W-22-3, JOB 4-17R, 1 JULY 1983-30 JUNE 1984. ALASKA DEPT. FISH AND GAME, JUNEAU. 83 PP.

HAB USE	HOME RNG	POP DENS	DEN SITE
DEN CHRON	AGE/SEX	WEIGHT	COVER
REP RATE			

AKSE,AK , , ,ABC

01053

SCHOEN, J.W. AND L. BEIER.

1986
BRCWN BEAR HABITAT PREFERENCES AND BROWN BEAR LOGGING AND MINING RELATIONSHIPS IN SOUTHEAST ALASKA.

FED. AID WILDL. REST. PROJ. W-22-4, JOB 4.17R. PROG. REP., JULY 1, 1984-JUNE 30, 1985. ALASKA DEP. FISH AND GAME, JUNEAU.

GEN DATA	CENSUS/TREND	POP DENS	MORT RATE
REP RATE	CANNIBAL	DEN	AGE/SEX
WEIGHT			

AKSE,AK , , ,ADIS

01054

SCHOEN, J.W., L.R. BEIER AND J.W. LENTFER.

IN PRESSA
DENNING ECOLOGY OF BROWN BEARS ON ADMIRALTY AND CHICHAGOF ISLANDS.

INT. CONF. BEAR RES. AND MANAGE. 7.

DEN CHRON	DEN SITE	DEN CHAR	MORT DATA
AIRCRAFT IMP	ENERGY IMP	TIMB-HAB	ENERGY MGMT

AKSE,AK , , ,ABC

01055

SCHOEN, J.W., J.W. LENTFER AND L. BEIER.

IN PRESSB
DIFFERENTIAL DISTRIBUTION OF BROWN BEARS ON ADMIRALTY ISLAND, SOUTHEAST ALASKA: A PRELIMINARY ASSESSMENT.

INT. CONF. BEAR RES. AND MANAGE. 6.

HAB USE	MOVE	DEN CHRON	DEN SITE
HOME RNG	AGE/SEX		

AKSE,AK , , ,ADIS

01056

SCHOENWALD-COX, C.M., S.M. CHAMBERS, B. MACBRYDE AND L. THOMAS.

GENETICS AND CONSERVATION, A REFERENCE FOR MANAGING WILD ANIMAL AND PLANT POPULATIONS.

BENJAMIN/CUMMINGS, LONDON. 722 PP.

GENETICS

,GEN , , ,

01057

SCHULLERY, P.

1980
THE BEARS OF YELLOWSTONE.

YELLOWSTONE LIBRARY & MUSEUM ASSOC., YELLOWSTONE NATL. PARK, WYO.
176 PP.

GEN BIOL   MGMT GEN   PCL/ADM MGMT   CENSUS/TREND
HUMAN INJ   CCNTRCL   DEPRED

YGBE,IMW ,YNP ,   ,

01058

SCOTTER, G.W.

1975
A GRIZZLY BEAR (URSUS ARCTOS) RECORD NEAR FORT SIMPSON, NORTHWEST TERRITORIES.

CAN. FIELD-NAT. 89(3):324.

PRES DISTR

BORF,NWT ,   ,   ,SIMP

01059

SEAL, U.S., A.W. ERICKSON AND J.G. MAYO.

1970
DRUG IMMOBILIZATION OF THE CARNIVORA.

INT. ZOO YEARB. 10:157-170.

DRUGS

,GEN ,   ,   ,

C1060

SEAL, U.S., W.R. SWAIM AND A.W. ERICKSON.

1967
HEMATOLOGY OF THE URSIDAE.

COMP. BIOCHEM. PHYSIOL. 22:451-460.

REPRO PHYS   HEMAT

,GEN ,   ,   ,

01061

SEBER, G.A.F.

1965
A NOTE ON THE MULTIPLE-RECAPTURE CENSUS.

BIOMETRIKA. 52:249-259.

CENSUS METH

,GEN , , ,

01062

SEITZ, B.

1983
SOUTH SAN JUAN MOUNTAINS GRIZZLY BEAR SURVEY.

FED. AID WILDL. REST PRCJ. SE-3-4, WORK PLAN 3, JOB 1. FINAL REP. , JAN. 1 - DEC. 31, 1982. COLO. DIV. WILDL., DENVER. 10 PP.

HAB RECON PRES DISTR

,CO , , ,

01063

SERVHEEN, C.

1977A
THE RELOCATION OF PROBLEM BEARS ON THE FLATHEAD INDIAN RESERVATIO N.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 7A. 5 PP.

RELOC MOVE

NCDE,MT ,FLIR, ,

01064

SERVHEEN, C.

1977B
THE RELOCATION OF GRIZZLY NO. 110.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 7C. 5 PP.

DEPRED RELOC AVER COND

NCDE,MT , , ,

01065

SERVHEEN, C.

1978
THE GRIZZLY BEAR IN THE RATTLESNAKE MOUNTAINS.

PP. 3-16 IN: C. JONKEL, ED. ANNUAL REPORT NO. 3. BORDER GRIZZLY P
ROJ., UNIV. MONT., MISSOULA.

DISTR	HAB RECON	HUMAN IMP	RECR IMP

NCDE,MT , , ,RATT

01066

SERVHEEN, C.

1981
GRIZZLY BEAR ECOLOGY AND MANAGEMENT IN THE MISSION MOUNTAINS, MON
TANA.

PH.D. DISS., UNIV. MONT., MISSOULA. 139 PP.

MOVE	HAB USE	FOOD	DEN
MGMT PLAN	HOME RNG	DIVERSITY	MEAS/QUANT
POP DENS			

NCDE,MT ,FLIR,USFS,MISS

01067

SERVHEEN, C.W.

1983
GRIZZLY BEAR FOOD HABITS, MOVEMENTS, AND HABITAT SELECTION IN THE
MISSION MOUNTAINS, MONTANA.

J. WILDL. MANAGE. 47(4):1026-1035.

FOOD	MOVE	SEAS BEH	HAB USE
HOME RNG	MEAS/QUANT	AGE/SEX	POP DENS

NCDE,MT ,FLIR,FLNF,MISS

01068

SERVHEEN, C.

1984
A BRIEF GUIDE TO REPORTING GRIZZLY BEAR OBSERVATIONS, SIGN MORTAL
ITIES, AND BEAR-RELATED PROBLEMS IN THE CONTIGUOUS 48 STATES.

APPENDIX 6, PP. 73-78 IN: J. PICTON AND P. ZAGER. 1985. WESTERN C
ABINET MOUNTAINS GRIZZLY BEAR HABITAT SURVEY, 1985. IDAHO FISH AN
D GAME,COEUR D'ALENE.

MONIT SYS	IDENT/RECOG

,US , , ,

01069

SERVHEEN, C.

1985
THE INVOLVEMENT OF CAPTIVE POPULATIONS IN THE RECOVERY OF THE THREATENED GRIZZLY BEAR (URSUS ARCTOS HORRIBILIS ORD.) IN THE LOWER 48.

PP. 499-506 IN: PROC. 1985 ANNU. CONF. AM. ASSOC. ZOOL. PARKS AND AQUARIUMS.

POP AUG

,US , , ,

C1070

SERVHEEN, C.

1986
HABITAT RESEARCH NEEDS FOR GRIZZLY BEAR RECOVERY.

PP. 14-18 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

MGMT GEN

,US , , ,

01071

SERVHEEN, C.

IN PRESS
THE MANAGEMENT OF THE THREATENED GRIZZLY BEAR IN THE CONTERMINOUS UNITED STATES.

PROC. INT. CONF. BEAR RES. AND MANAGE. 7. (PAPER PRESENTED)

DISTR	POP EST	MGMT GEN	POL/ADM MGMT
MIN POP	CENSUS METH	GENETICS	POP AUG
HUMAN IMP			

,US , , ,

01072

SERVHEEN, C., W. KASWORM AND A. CHRISTENSEN.

IN PRESS
APPROACHES TO AUGMENTING GRIZZLY BEAR POPULATIONS IN THE CABINET MOUNTAINS OF MONTANA.

INT. CONF. BEAR RES. AND MANAGE. 7: .

POP AUG

CYE ,MT , , ,

01073

SERVHEEN, C. AND R. KLAVER.

1983
GRIZZLY BEAR DENS AND DENNING ACTIVITY IN THE MISSION AND RATTLES
NAKE MOUNTAINS, MONTANA.

INT. CONF. BEAR RES. AND MANAGE. 5:201-207.

DEN SITE DEN CHAR DEN CHRON

NCDE,MT ,USFS,FLIR,

01074

SERVHEEN, C. AND L.C. LEE.

1979A
AN ASSESSMENT OF THE GRIZZLY BEAR POPULATION SIZE AND STATUS, AND
A DESCRIPTION OF IMPORTANT GRIZZLY USE SITES IN THE FINLEY LOGGI
NG UNIT, FLATHEAD RESERVATION, MONTANA.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. 64 PP.

TYPE DESCRIP HAB USE PRES DISTR MOVE
HAB RECON POP EST ZONING

NCDE,MT ,FLIR, ,

01075

SERVHEEN, C. AND L.C. LEE.

1979B
MISSION MOUNTAINS GRIZZLY BEAR STUDIES, AN INTERIM REPORT, 1976-7
8.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. 299 PP.

HAB USE HOME RNG TYPE DESCRIP FOOD
POP BIOL DEN MOVE

NCDE,MT ,FLIR, ,MISS

01076

SERVHEEN, C., T.T. THIER, C.J. JONKEL AND D. BEATY.

1981
AN EAR-MOUNTED TRANSMITTER FOR BEARS.

WILDL. SOC. BULL. 9(1):56-57.

TELEM

,GEN , , ,

01077

SERVHEEN, C. AND T. WOJCIECHOWSKI.

1978
GRIZZLY BEAR FOOD LIST.

PP 83-107 IN: C. JONKEL, ED. BORDER GRIZZLY PRCJ., UNIV. MCNT., M
ISSOULA. ANNU. REP. NO. 3.

FOOD

,GEN , , ,

01078

STENHOUSE, G. AND M. CATTET.

1984
BEAR DETECTION AND DETERRENT STUDY CAPE CHURCHILL, MANITOBA, 1983
.

NORTHWEST TERRIT. WILDL. SERV., YELLOWKNIFE. REP. NO. 44. 59 PP
.

DETER/REPEL

,NWT , , ,

01079

SHAFFER, M.L.

1978
DETERMINING MINIMUM VIABLE POPULATICN SIZES: A CASE STUDY OF THE
GRIZZLY BEAR (URSUS ARCTOS L.).

PH.D. DISS., DUKE UNIV., DURHAM, N.C. 190 PP.

DEMOG ANAL	MORT RATE	REP RATE	AGE/SEX
GENETICS	POP REG	MIN POP	

,GEN , , ,

01080

SHAFFER, M.L.

1981
MINIMUM POPULATION SIZES FOR SPECIES CONSERVATICN.

BIOSCIENCE 31(2):131-134.

MIN POP

,GEN , , ,

01081

SHAFFER, M.L.

1983
DETERMINING MINIMUM VIABLE POPULATION SIZES FOR THE GRIZZLY BEAR.

INT. CONF. BEAR RES. AND MANAGE. 5:133-139.

MIN POP

YGBE,IMW , , ,

01082

SHAFFER, M.L.

1986
ASSESSMENT OF APPLICATION OF SPECIES VIABILITY THEORIES.

PREP. FOR OFF. TECHNOLOGY ASSESSMENT, U.S. CONGRESS. DRAFT REP.

DEMOG ANAL MIN POP GENETICS

,GEN , , ,

01083

SHAFFER, M.L. AND F.B. SAMSON.

1985
POPULATION SIZE AND EXTINCTION: A NOTE ON DETERMINING CRITICAL PO
PULATION SIZES.

AM. NAT. 125(1):144-152.

MIN POP

,GEN , , ,

01084

SHAFFER, S.C.

1971
SOME ECOLOGICAL RELATIONSHIPS OF GRIZZLY BEARS AND BLACK BEARS OF
THE APGAR MOUNTAINS IN GLACIER NATIONAL PARK, MONTANA.

M.S. THESIS, UNIV. MONT., MISSOULA. 133 PP.

VEG SUCC MARK CENSUS/TREND FOOD
HAB USE CARCASS ACT PATT INTERSP COMP
DEN
NCDE,MT ,GLNP, ,APGR

01085

SHANK, C.C.

1979
HUMAN-RELATED BEHAVIOURAL DISTURBANCE TO NORTHERN LARGE MAMMALS: A BIBLIOGRAPHY AND REVIEW.

PREP. FOR FOOTHILLS PIPE LINES (YUKON) LTD., CALGARY. 253 PP.

BIBLIO ENERGY IMP

,GEN , , ,

01086

SHERWOOD, H.W.

1981
MORPHOLOGICAL VARIATION OF GRIZZLY BEAR SKULLS FROM YELLOWSTONE N ATIONAL PARK.

M.S. THESIS, UNIV. MONT., MISSOULA. 96 PP.

DENT SKULL TAXON/EVOL

YGBE,IMW , , ,

01087

SHOOK, G.L. AND G.E. FOLK, JR.

1965
BODY MOISTURE AND THE OPERATING LIFE OF IMPLANTABLE HEART RATE TR ANSMITTERS.

IEEE TRANS. BIO-MEDICAL ENG. BME-12(1):44-46.

TELEM

,GEN , , ,

01088

SHUMAN, R.F.

1950
BEAR DEPREDATIONS ON RED SALMON SPAWNING POPULATIONS IN THE KARLU K RIVER SYSTEM, 1947.

J. WILDL. MANAGE. 14(1):1-9.

PRED

AKKA,AK , , ,KARL

01089

SIDOROWICZ, G.A. AND F.F. GILBERT.

1981
THE MANAGEMENT OF GRIZZLY BEARS IN THE YUKON, CANADA.

WILDL. SOC. BULL. 9(2):125-135.

HARV DATA POP DENS HARV MGMT DEMOG ANAL
HARV IMP

,YK , , ,

C1090

SIGMAN, M.J.

1985
IMPACTS OF CLEARCUT LOGGING ON THE FISH AND WILDLIFE RESOURCES OF SOUTHEAST ALASKA.

ALASKA DEP. FISH AND GAME, HABITAT DIVISION, JUNEAU. TECH. REP. NO. 85-3.

TIMB IMP TIMB MGMT RCAD IMP

,GEN , , ,

01091

SIMPSON, K. AND D. HEBERT.

CA. 1982
REVELSTOKE GRIZZLY-CARIBOU STUDY.

B.C. WILDL. BRANCH, VICTORIA. 24 PP.

HOME RNG FOOD HAB USE AGE/SEX
WEIGHT

BC-I,BC , , ,REVL

01092

SINGER, F.J.

1978
SEASONAL CONCENTRATIONS OF GRIZZLY BEARS, NORTH FORK OF THE FLATHEAD RIVER, MONTANA.

CAN. FIELD-NAT. 92(3):283-286.

FOOD HAB USE PRED CARCASS

NCDE,BCMT,GLNP,FLNF,NFLT

01093

SINGER, F.J.

1982
PROBLEM ANALYSIS - GRIZZLY BEAR MANAGEMENT, DENALI NATIONAL PARK.

U.S.D.I., NATL. PARK SERV., DENALI NATL. PARK, ALASKA. 41 PP.

MONIT SYS   HUMAN INJ   MOTOR IMP   CAMP MGMT
REACTION   NONMOT MGMT   CONTROL   NONMOTOR IMP

AK-I,AK ,DENP, ,

01094

SINGER, F.J. AND J.B. BEATTIE.

IN PRESS
THE CONTROLLED TRAFFIC SYSTEM AND ASSOCIATED WILDLIFE RESPONSES I
N DENALI NATIONAL PARK.

ARCTIC.

MOTOR MGMT   MOTOR IMP   ROAD IMP

AK-I,AK ,DENP, ,

01095

SIZEMORE, D.L.

1980
FORAGING STRATEGIES OF THE GRIZZLY BEAR AS RELATED TO ITS ECOLOGI
CAL ENERGETICS.

M.S. THESIS, UNIV. MONT., MISSOULA, 67 PP.

HOME RNG   NUTR ANAL   MOVE   WEIGHT
AGE/SEX   FOOD   SEAS BEH   ACT PATT
NUTR
NCDE,MT , , ,SFLT

01096

SKJONSBERG, T. AND A. WESTHAVER.

1978
A STUDY IN THE CHEMICAL IMMOBILIZATION OF ANIMALS WITH SUGGESTION
S FOR APPLICATION IN CANADA'S NATIONAL PARKS.

PROC. WEST. BLACK BEAR. WORKSHOP 1:283-318.

DRUGS

,GEN , , ,

01097

SKOOG, R.

1954
INTERIOR ALASKA CHECKING STATION OPERATIONS - FIRST SEASON, 1954.

FED. AID WILDL. REST. PROJ. JOB NO. 2, WORK PLAN B. ALASKA DEP. FISH AND GAME, JUNEAU. 2 PP.

HARV DATA

AK-I,AK , , ,STEE

01098

SLANEY, F.F. AND COMPANY, LTD.

1974
1972-1974 ENVIRONMENTAL PROGRAM, MACKENZIE DELTA.

DISTR. BY PALLISTER RESOUR. MANAGE. LTD.

HIST DISTR	PRES DISTR	DEN SITE	HAB USE
DEN CHRON	PRED	HARV MGMT	MISC QUANT

CARC,NWT , , ,RICH

01099

SMITH, B.L.

1978
INVESTIGATIONS INTO BLACK AND GRIZZLY BEAR RESPONSES TO COASTAL LOGGING - 1977.

B.S. THESIS, SIMON FRASER UNIV., BURNABY, B.C. 85 PP.

FOOD	TIMB IMP	CUT USE	VEG SUCC
CENSUS METH	ACT PATT	MARK	TIMB-METH
COVER			

BC-C,BC , , ,AHNU

01100

SMITH, B.L.

1980
SOME THREATS TO THE FUTURE OF GRIZZLY BEARS IN WESTERN CANADA.

PP 222-226 IN: R. STACE-SMITH, L. JOHNS AND P. JOSLIN, EDS. THREATENED AND ENDANGERED SPECIES AND HABITATS IN BRITISH COLUMBIA AND THE YUKON.

MGMT GEN	HUMAN IMP	HAB EFFECT

,GEN , , ,

01101

SMITH, B.L.

IN PREPA
REPRODUCTIVE PERFORMANCE OF FEMALE GRIZZLY BEARS IN THE OGILVIE M
OUNTAINS, YUKON.

DRAFT ABSTRACT. YUKON DEP. RENEWABLE RESOUR., WHITEHORSE.

REP RATE

,YK , , ,

01102

SMITH, B.L.

IN PREPB
VULNERABILITY TO HARVEST IN GRIZZLY BEARS IN THE CENTRAL YUKON, C
ANADA.

DRAFT ABSTRACT. YUKON DEP. RENEWABLE RESOUR., WHITEHORSE.

HARV DATA HARV MGMT

,YK , , ,

01103

SMITH, B.L.

IN PREPC
ALLOCATION OF HARVESTABLE GRIZZLY BEARS USING A POINT SYSTEM WEIG
HTED BY BEAR SEX.

DRAFT ABSTRACT. YUKON DEP. RENEWABLE RESOUR., WHITEHORSE.

HARV MGMT

,YK , , ,

01104

SMITH, J.K.

1983
BIMS - THE BEAR REPORTING NETWORK FOR THE NATIONAL PARK SERVICE.

INT. CONF. BEAR RES. AND MANAGE. 5:297-301.

MONIT SYS

,US ,NPS , ,

01105

SMITH, M.E.

1983
REPELLENTS AND DETERRENTS FOR BLACK AND GRIZZLY BEARS, PROGRESS R
EPORT.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. 21 PP.

DETER/REPEL AVER COND

,GEN , , ,

01106

SMITH, R.B. AND L. VAN DAELE.

1984
TERROR LAKE HYDROELECTRIC PROJECT. 1982 BROWN BEAR STUDIES.

PREP. BY ALASKA DEP. FISH AND GAME. PREP. FOR ALASKA POWER AUTHOR
ITY. 107 PP.

ENERGY IMP	GEN DATA	DEN	LITR SIZE
MORT DATA	WEAN	PCP EST	AGE/SEX
PRED			

AKKA,AK , , ,TERL

01107

SMITH, R.B., L. VAN DAELE AND L.A. METZ.

1984
TERROR LAKE HYDROELECTRIC PROJECT. REPORT ON BROWN BEAR STUDIES,
1983.

PREP. BY ALASKA DEP. FISH AND GAME. PREP. FOR ALASKA POWER AUTHOR
ITY. 77 PP.

AGE/SEX	MORT DATA	REP RATE	HAB USE
FOOD	MOVE	HOME RNG	ENERGY IMP
DEN			

AKKA,AK , , ,TERL

01108

SMITS, C.M.M. AND B.L. SMITH.

IN PREP
FEASIBILITY OF THE USE OF OBSERVATIONS OF GRIZZLY BEARS BY OUTFIT
TERS AND HUNTING GUIDES IN GRIZZLY BEAR POPULATION INVENTORY AND
TREND IN REGISTERED GUIDING AREAS OF THE YUKON.

DRAFT ABSTRACT. YUKON DEP. RENEWABLE RESOUR., WHITEHORSE.

CENSUS METH

,YK , , ,

01109

SOULE, M.E. AND B.A. WILCOX.

1980
CONSERVATION BIOLOGY: AN ECOLOGICAL-EVOLUTIONARY PERSPECTIVE.

SENAUER ASSOC., SUNDERLAND, MASS. 395 PP.

GENETICS

,GEN , , ,

01110

SOUTHWOOD, T.R.E.

1966
ECOLOGICAL METHODS.

CHAPMAN AND HALL, LONDON.

HOME RNG

,GEN , , ,

01111

SPALDING, D., B. GATES, W. MCKAY AND K. MUNDY.

1972
MANAGEMENT PLAN FOR BRITISH COLUMBIA'S GRIZZLY BEARS.

PREP. BY CARNIVORE COMM., B.C. FISH AND WILDL. BRANCH, VICTORIA.
21 PP.

MGMT PLAN MGMT GEN HARV DATA POP EST
POACH/ILLEG HARV MGMT

,BC , , ,

01112

SPARROWE, R.D.

1968
SEXUAL BEHAVIOR OF GRIZZLY BEARS.

AM. MIDL. NAT. 80(2):570-572.

COPULATE

YGBE,WY ,YNP , ,

01113

SPENCE, L.E., JR.

1963
STUDY OF IDENTIFYING CHARACTERISTICS OF MAMMAL HAIR.

FED. AID WILDL. REST. PROJ. FW-3-R-10, JOB. NO. 2W, WORK PLAN NO. 10. JOB COMPLETION REP. JULY 1, 1962-JUNE 30, 1963. WILDL. DISEASE RES. LABORATORY, WYO. GAME AND FISH COMMISSION. 131 PP.

HAIR

,GEN , , ,

01114

SPENCER, D.L. AND R.J. HENSEL.

1980
ENVIRONMENTAL STUDIES OF THE PROPOSED TERROR LAKE HYDROELECTRIC PROJECT, KODIAK ISLAND, ALASKA. BROWN BEARS STUDIES. MOUNTAIN GOAT STUDIES.

PREP. FOR KODIAK ELECTRIC ASSOC. INC. PREP. BY ARCTIC ENVIRON. INF. AND DATA CENT., UNIV. ALASKA, ANCHORAGE. 100 PP.

ENERGY IMP DEN SITE DEN CHAR MOVE
SEAS BEH HAB USE POP BIOL

AKKA,AK ,KNWR, ,TERL

01115

SPIESS, A.

1976
LABRADOR GRIZZLY (URSUS ARCTOS L.): FIRST SKELETAL EVIDENCE.

J. MAMMAL. 57(4):787-790.

SKULL HIST DISTR

,ECAN, , ,

01116

SPIESS, A. AND S. COX.

1976
DISCOVERY OF THE SKULL OF A GRIZZLY BEAR IN LABRADOR.

ARCTIC 29(4):194-200.

HIST DISTR SKULL

,ECAN, , ,

01117

SPRAKER, T. AND W. BALLARD.

1979
FEEDING BEHAVIOR OF INTERIOR BROWN BEARS.

FED. AID WILDL. REST. PROJ. W-17-10 AND W-17-11, JOB 4.13R. PROG. REP., VOL. I. ALASKA DEP. FISH AND GAME, JUNEAU. 19 PP.

AGE/SEX	RES MORT	DRUGS	BRD AGE
LITR SIZE	PHYS CHEM	HEMAT	MEAS/QUANT

AKSC,AK , , ,NESU

01118

SPRAKER, T.H., W.B. BALLARD AND S.D. MILLER.

1981
GAME MANAGEMENT UNIT 13 BROWN BEAR STUDIES.

FED. AID WILDL. REST. PROJ. W-17-10, W-17-11, W-21-1, JOB 4.13R. FINAL REP., JAN. 1, 1978-JUNE 30, 1980. ALASKA DEP. FISH AND GAME , JUNEAU. 57 PP.

DRUGS	MEAS/QUANT	AGE/SEX	LITR SIZE
BRD AGE	PHYS CHEM	FOOD	PRED
HEMAT			

AKSC,AK , , ,NESU

C1119

SPREADBURY, B.

1984
YUKON GRIZZLY BEAR TRANSPLANT PROJECT.

YEAR 1 PROGRESS REPORT-1984. PREP. FOR THE YUKCN FISH AND WILDL. BRANCH, ENVIRONENT CANADA, YUKON FISH AND GAME ASSOC. AND UNIV. C ALGARY.

RELOC	MOVE	AIRCRAFT IMP	ROAD IMP
ENERGY IMP	REACTION		

NINT,YK , , ,

C1120

STEBLER, A.M.

1972
CONSERVATION OF THE GRIZZLY - ECOLOGIC AND CULTURAL CONSIDERATION S.

INT. CONF. BEAR RES. AND MANAGE. 2:297-303.

HIST ACCT	HIST DISTR

,GEN , , ,

01121

STELMOCK, J.J.

1981
SEASONAL ACTIVITIES AND HABITAT USE PATTERNS OF BROWN BEARS IN DE
NALI NATIONAL PARK - 1980.

M.S. THESIS, UNIV. ALASKA, FAIRBANKS. 118 PP.

FOOD INTRASP BEH MAP/TYPE | ACT PATT COURT | BEHAV PATT NUTR ANAL | HAB USE PRED

AK-I,AK ,DENP, ,

01122

STENHOUSE, G.

1982
BEAR DETECTION AND DETERRENT STUDY, CAPE CHURCHILL, MANITOBA, 198
1.

NORTHWEST TERRIT. WILDL. SERV., YELLOWKNIFE. REP. NO. 23. 65 PP

DETER/REPEL

,GEN , , ,

01123

STENHOUSE, G.

1983
BEAR DETECTION AND DETERRENT STUDY, CAPE CHURCHILL, MANITOBA, 198
2.

NORTHWEST TERRIT. WILDL. SERV., YELLOWKNIFE. REP. NO. 31. 58 PP

DETER/REPEL

,GEN , , ,

01124

STEPHENSON, R.O.

1978
UNIT 13 WOLF STUDIES.

FED. AID WILDL. REST. PROJ. W-17-8, JOB NOS. 14.8R, 14.9R AND 14.
10R. PROG. REP., VOL I. ALASKA DEP. FISH AND GAME, JUNEAU. 75 PP.

PRED CARCASS INTERSP COMP

AK-I,AK , , ,COPR

01125

STEWART, G.R., J.M. SIPEREK AND V.R. WHEELER.

1980
USE OF THE CATALEPTOID ANESTHETIC CI-744 FOR CHEMICAL RESTRAINT O
F BLACK BEARS.

INT. CONF. BEAR RES. AND MANAGE. 4:57-61.

DRUGS

,GEN , , ,

01126

STICKEL, L.F.

1954
A COMPARISON OF CERTAIN METHODS OF MEASURING RANGES OF SMALL MAMM
ALS.

J. MAMMAL. 35(1):1-15.

HOME RNG

,GEN , , ,

01127

STIRLING, I., A.M. PEARSON AND F.L. BUNNELL.

1976
POPULATION ECOLOGY STUDIES OF POLAR AND GRIZZLY BEARS IN NORTHERN
CANADA.

TRANS. NORTH AM. WILDL. AND NAT. RESOUR. CONF. 41:421-430.

DEMOG ANAL HARV MGMT HARV IMP

,CAN , , ,

01128

STOCKSTAD, D.

1953
GRIZZLY BEAR INVESTIGATION AND RECHECK.

FED. AID WILDL. REST. PROJ. W-60-R-1, WORK PLAN 7, JOB 7-A. PROG.
REP., JULY 15, 1953-SEP. 26, 1953. MONT. DEP. FISH AND GAME, HEL
ENA. 4 PP.

CENSUS/TREND

NCDE,MT ,FLNF,LCNF,

01129

STOCKSTAD, D.

1954
GRIZZLY BEAR INVESTIGATION AND RECHECK.

FED. AID WILDL. REST. PROJ. W-60-R-1, WORK PLAN 7, JOB 7-A. JOB C
CMPLETION REP. MONT. DEP. FISH AND GAME, HELENA. 13 PP.

CENSUS/TREND   HARV DATA

NCDE,MT   ,FLNF,LCNF,

01130

STOKES, A.W.

1970
AN ETHOLOGIST'S VIEWS ON MANAGING GRIZZLY BEARS.

BIOSCIENCE 20(21):1154-1157.

INTRASP BEH   AGON   POP REG   MGMT GEN
GARBAGE   RELOC   CONTROL

,GEN ,   ,   ,

01131

STOKES, A.W., A.L. EGBERT AND M.H. LUQUE.

1981
SOCIAL BEHAVIOR OF BROWN BEARS AT MCNEIL RIVER, ALASKA

PP 583-590 IN: P.H. OEHSER, J.S. LEA AND N.L. POWARS, EDS. NATION
AL GEOGRAPHIC SOCIETY RESEARCH REPORTS, 1971 TO 1972, VOL. 13. NA
TL. GEOG. SOC., WASHINGTON, D.C.

AGE/SEX   INTRASP BEH   FEED BEH   PRED
ACT PATT   AGON   MATERNAL
TERR/SPACE
AKPN,AK   ,MCGS,   ,MCNE

01132

STONEBERG, R.P. AND C.J. JONKEL.

1966
AGE DETERMINATION OF BLACK BEARS BY CEMENTUM LAYERS.

J. WILDL. MANAGE. 30(2):411-414.

AGE DETERM

,GEN ,   ,   ,

01133

STONOROV, D. AND A.W. STOKES.

1972
SOCIAL BEHAVIOR OF THE ALASKAN BROWN BEAR.

INT. CONF. BEAR RES. AND MANAGE. 2:232-242.

TERR/SPACE AGE/SEX AGON INTRASP BEH
THREAT

AKPN,AK ,MCGS, ,MCNE

01134

STORER, T.I. AND L.P. TEVIS, JR.

1978
CALIFORNIA GRIZZLY.

UNIV. NEBR. PRESS, LINCOLN. 335 PP.

HIST DISTR HIST ACCT GEN BIOL

,CA , , ,

01135

STOVELL, P.L.

1972
BEAR MEAT TRICHINOSIS.

CAN. MED. ASSOC. J. 107(11):1056.

PARAS/DIS

,GEN , , ,

01136

STRATHEARN, S.M., J.S. LOTIMER, G.B. KOLEMOSKY AND W.M. LINTACK.

1984
AN EXPANDING BREAK-AWAY RADIO COLLAR FOR BLACK BEAR.

J. WILDL. MANAGE. 48(3):939-942.

TELEM

,GEN , , ,

01137

STRINGHAM, S.F.

1980
POSSIBLE IMPACTS OF HUNTING ON THE GRIZZLY/BROWN BEAR, A THREATEN ED SPECIES.

INT. CONF. BEAR RES. AND MANAGE. 4:337-349.

HARV IMP	BRD AGE	LITR FREQ	LITR SIZE
POP REG		INTRASP BEH	

,GEN , , ,

01138

STRINGHAM, S.F.

1983
ROLES OF ADULT MALE IN GRIZZLY BEAR POPULATION BIOLOGY.

INT. CONF. BEAR RES. AND MANAGE. 5:140-151.

DEMOG ANAL	POP REG	LITR SIZE	REP RATE
	AGON	INTRASP BEH	

,GEN , , ,

01139

STRINGHAM, S.F.

1984
RESPONSES BY GRIZZLY BEAR POPULATION DYNAMICS TO CERTAIN ENVIRONM ENTAL AND BIOSOCIAL FACTORS.

PH.D. DISS., UNIV. TENN., KNOXVILLE. 464PP.

POP REG	DEMOG ANAL	REP RATE	AGE/SEX
CLIMATE	GARBAGE	INTRASP BEH	AGON

,GEN , , ,

C1140

STRINGHAM, S.F.

1986
BEARS, LORDS OF THE WILDERNESS: ECOLOGY, BEHAVIOR, AND POPULATION DYNAMICS.

NOYES PUBL., N.J. 570 PP.

DEMOG ANAL	POP REG		GEN DATA
CLIMATE	GROW/DEV	MORPH/PHYS	INTRASP BEH
REP RATE			

,GEN , , ,

01141

STRINGHAM, S.F.

IN PRESSA
CHANGES IN LITTER SIZE FOR YELLOWSTONE GRIZZLIES RELATIVE TO GARB
AGE CONSUMPTION, DUMP CLOSURE AND CLIMATE.

INT. CONF. BEAR RES. AND MANAGE. 6.

GARBAGE LITR SIZE REP RATE CLIMATE
INTRASP BEH POP REG

YGBE,IMW , , ,

01142

STRINGHAM, S.F.

IN PRESSB
BEAR DEMOGRAPHICS AS FUNCTIONS OF FOOD SUPPLY PER UNIT POPULATION
BIOMASS, BODY SIZE, AND OTHER INDICES OF NUTRITIONAL STATUS.

INT. CONF. BEAR RES. AND MANAGE. 7:000-000.

POP REG REP RATE WEIGHT

,GEN , , ,

01143

STRINGHAM, S.F.

IN PREP
REPRODUCTION BY YELLOWSTONE GRIZZLY BEARS RELATIVE TO FOOD AND CL
IMATE.

CRAFT MANUSCRIPT.

LITR SIZE REP RATE POP REG CLIMATE
GARBAGE

YGBE,IMW , , ,

01144

STUART, T.W.

1977
MULTIOBJECTIVE ANALYSIS OF WILDERNESS TRAVEL IN GRIZZLY BEAR HABI
TAT USING PARAMETRIC LINEAR PROGRAMMING.

PH.D. DISS., UNIV. CALIF., BERKELEY. 241 PP.

NONMOT MGMT CAMP MGMT

NCDE,MT ,GLNP, ,

01145

STUART, T.W.

1978
MANAGEMENT MODELS FOR HUMAN USE OF GRIZZLY BEAR HABITAT.

TRANS. NORTH AM. WILDL. AND NAT. RESOUR. CONF. 43:434-441.

NONMOT MGMT CAMP MGMT

NCDE,MT ,GLNP, ,

01146

STUART, T.W.

1980
EXPLORATION OF OPTIMAL BACKCOUNTRY TRAVEL PATTERNS IN GRIZZLY BEA
R HABITAT.

INT. CONF. BEAR RES. AND MANAGE. 4:25-32.

NONMOT MGMT

NCDE,MT ,GLNP, ,

01147

SUCHY, W.J., L.L. MCDONALD, M.D. STRICKLAND AND S.H. ANDERSON.

1985
NEW ESTIMATES OF MINIMUM VIABLE POPULATION SIZE FOR GRIZZLY BEARS
OF THE YELLOWSTONE ECOSYSTEM.

WILDL. SOC. BULL. 13:223-228.

MIN POP DEMOG ANAL

YGBE,IMW , , ,

01148

SULLIVAN, P.T.

1983
A PRELIMINARY STUDY OF HISTORIC AND RECENT REPORTS OF GRIZZLY BEA
RS, URSUS ARCTOS, IN THE NORTH CASCADES AREA OF WASHINGTON.

WASH. DEP. OF GAME, OLYMPIA. 32 PP.

HIST DISTR HIST ACCT PRES DISTR

NCE ,BCWA, , ,

01149

SUMMERFIELD, B.

1978
INVESTIGATIONS OF GRIZZLY BEAR - CATTLE RELATIONSHIPS IN THE COW CREEK AND GRASS CREEK DRAINAGES.

U.S.D.A., FOREST SERV., IDAHO PANHANDLE NATL. FORESTS. 20 PP.

LIVESTK IMP   LIVESTK MGMT

SME ,ID ,IPNF, ,

01150

SUMNER, J. AND J.J. CRAIGHEAD.

1973
GRIZZLY BEAR HABITAT SURVEY IN THE SCAPEGOAT WILDERNESS, MONTANA.

MONT. COOP. WILDL. RES. UNIT, UNIV. MONT., MISSOULA. 68 PP.

FOOD   FEED BEH   CENSUS METH   CENSUS/TREND
HAB EFFECT   HAB RECON

NCDE,MT ,USFS, ,SCAP

01151

SUNDSTROM, T.C.

1985
AN ANALYSIS OF DENALI NATIONAL PARK AND PRESERVE'S MANAGEMENT PROGRAM TO EDUCATE VISITORS REGARDING BEHAVIOR WHILE IN BEAR COUNTRY.

M.S. THESIS, UNIV. WYO., LARAMIE. 291 PP.

PUBLIC ATT   EDUC   NONMOT MGMT

AK-I,AK ,DENP, ,

01152

SUTTERLIN, L.M.

1985
INTERPRETATION OF BEARS IN WATERTON LAKES NATIONAL PARK.

M.S. PROJ., UNIV. OF CALGARY, ALBERTA. 71 PP.

PUBLIC ATT   EDUC

CR ,AT ,WANP, ,

01153

SUTTON, R.W.

1967
POSSIBLE RECENT OCCURRENCE OF GRIZZLY IN MANITOBA.

BLUE JAY 24:190-191.

HIST DISTR

,MNTB, , ,

01154

SVIHLA, A., H. BOWMAN AND R. PEARSON.

1955
BLOOD PICTURE OF THE AMERICAN BLACK BEAR, URSUS AMERICANUS.

J. MAMMAL. 36(1):134-135.

HEMAT

,GEN , , ,

01155

TAIT, D.E.N.

1980
ABANDONMENT AS A REPRODUCTIVE TACTIC - THE EXAMPLE OF GRIZZLY BEA
RS.

AM. NAT. 115(6):800-808.

REPRO MATERNAL REP RATE

,GEN , , ,

C1156

TAIT, D.E.

1983
AN ANALYSIS OF HUNTER KILL DATA.

PH.D. THESIS, UNIV. OF B.C., VANCOUVER. 129 PP.

HARV MGMT

,GEN , , ,

01157

TAYLOR, J.S.

1984
BEAR MANAGEMENT PLANS IN CANADIAN NATIONAL PARKS: FIFTEEN ESSENTI
AL ELEMENTS.

M.S. THESIS, UNIV. OF CALGARY, ALBERTA. 345 PP.

MGMT PLAN	NONMOT MGMT	MOTOR MGMT	LEGAL
EDUC	MGMT GEN	CAMP MGMT	GARB MGMT
MONIT SYS			

,CAN , , ,

01158

TAYLOR, M., J.S. CARLEY AND F.L. BUNNELL.

IN PRESS
RECRUITMENT RATES FOR AGE-STRUCTURED POPULATIONS WITH MULTI-ANNUA
L REPRODUCTION SCHEDULES.

MANUSCRIPT. 19 PP.

DEMOG ANAL

,GEN , , ,

01159

TAYLOR, R.A.

1964
COLUMBIAN GROUND SQUIRREL AND CAMBIUM FOUND IN GRIZZLY BEAR STOMA
CHS TAKEN IN THE FALL.

J. MAMMAL. 45(3):476-477.

FOOD

NCDE,MT ,FLNF, ,MISS

01160

THIER, T.J.

1981
CABINET MOUNTAINS GRIZZLY BEAR STUDIES, 1979-1980.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 50. 6
4 PP.

CAPTURE		IDENT/RECOG	
FOOD	MGMT GEN	HAB RECON	MAP/TYPE

CYE ,MT , , ,CAB

01161

THIER, T. AND D. SIZEMORE.

1981
AN EVALUATION OF GRIZZLY RELOCATIONS IN THE BGP AREA, 1975-1980.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 47. 16 PP.

RELOC MOVE HUMAN IMP LIVESTK IMP
AGE/SEX MGMT GEN

NCDE,MT , , ,

01162

TIETJE, W.D. AND R.L. RUFF.

1977
A CONTRIBUTION TOWARDS A CURRENT BIBLIOGRAPHY ON BEAR BIOLOGY, MANAGEMENT AND RESEARCH.

DEP. WILDL. ECOL., UNIV. WIS., MADISON. 63 PP.

BIBLIO

,GEN , , ,

01163

TIRMENSTEIN, D.A.

1983
GRIZZLY BEAR HABITAT AND MANAGEMENT IN THE RATTLESNAKE NATIONAL RECREATION AREA AND WILDERNESS.

M.S. THESIS, UNIV. MONT., MISSOULA. 213 PP.

PRES DISTR MAP/TYPE MOTOR IMP NONMOTOR IMP
MOTOR MGMT NONMOT MGMT ROAD MGMT

NCDE,MT ,LONF, ,RATT

01164

TOLLEFSON, M.

1975A
BEAR MANAGMENT INFORMATION.

MEMO. TO ROLLIE OSTERMICK, ALASKA TASK FORCE. FROM KATMAI NATL. PARK AND PRESERVE, ALASKA. 2 PP.

DEPRED HUMAN INJ CONTROL

AKPN,AK ,KANM, ,

01165

TOLLEFSON, M.

1975B
SUMMARY OF BEAR DAMAGE, SUMMER OF 1975.

MEMO. TO SUPERINTENDENT, KATMAI NATL. PARK AND PRESERVE, ALASKA.
2 PP.

DEPRED HUMAN INJ CONTROL

AKPN,AK ,KANM, ,

01166

TOMPA, F.S.

1984
GRIZZLY BEARS IN BRITISH COLUMBIA - HARVEST MUST BE REDUCED.

PRES. AT ANNU. CONF. WEST. ASSOC. FISH AND WILDL. AGENCIES, JULY
1984, VICTORIA, B.C. 9 PP.

HARV IMP HARV MGMT

,BC , , ,

01167

TOTH, T. AND L. SINKEY.

1983
VEGETATION MAPPING IN THE CASCADE VALLEY.

PP. 287-303 IN: D. HAMER AND S. HERRERO, ED. ECOLOGICAL STUDIES O
F THE GRIZZLY BEAR, BANFF NATIONAL PARK. PREP. FOR PARKS CANADA C
ONTRACT WR 4-80. UNIV. CALGARY, ALBERTA. FINAL REP.

MAP/TYPE

CR ,AT ,BANP, ,CASC

01168

TOVELL, W.M. AND R.E. DUANE.

1966
GRIZZLY BEAR SKULL: SITE OF A FIND NEAR LAKE SIMCOE.

SCIENCE 154(3745):158.

HIST DISTR

,ONT , , ,

01169

TRACY, D.M.

1977
REACTIONS OF WILDLIFE TC HUMAN ACTIVITY ALONG MCUNT MCKINLEY NATI
ONAL PARK ROAD.

M.S. THESIS, UNIV. ALASKA, FAIRBANKS. 260 PP.

POP DENS CENSUS/TREND REACTION MOTOR IMP
ROAD IMP

AK-I,AK ,DENP, ,

01170

TRACY, D.M., F.C. DEAN, C.M. ANDERSON AND T.M. JORDAN.

1982
BROWN BEAR BIBLIOGRAPHY.

ALASKA COOP. PARK STUDIES UNIT, UNIV. ALASKA, FAIRBANKS.

BIBLIO

,GEN , , ,

01171

TREVINO, J.C.

N.D.
STATUS OF THE MEXICAN WOLF AND GRIZZLY BEAR IN NORTHERN MEXICO.

U.S.D.A., FOREST SERV. GEN. TECH. REP., WO NO. 36:78-80.

HIST DISTR PRES DISTR

,MEX , , ,

01172

TREVINO, J.C. AND C. JONKEL.

IN PRESS
DO GRIZZLIES STILL LIVE IN MEXICO?

INT. CONF. BEAR RES. AND MANAGE. 6.

PRES DISTR

,MEX , , ,

01173

TROYER, W.A.

1961
THE BROWN BEAR HARVEST IN RELATION TO MANAGEMENT ON THE KODIAK IS LANDS.

TRANS. NORTH AM. WILDL. AND NAT. RESOUR. CONF. 26:460-468.

HARV DATA HARV MGMT AGE/SEX

AKPN,AK ,KNWR, ,KOIS

01174

TROYER, W.A.

1962
SIZE, DISTRIBUTION, STRUCTURE AND HARVEST OF A KODIAK BEAR POPULA TION.

M.S. THESIS, MONT. STATE UNIV., BOZEMAN. 48 PP.

HIST DISTR POP DENS CENSUS/TREND
LITR SIZE AGE/SEX HARV DATA MISC QUANT

AKKA,AK ,KNWR, ,KARL

01175

TROYER, W.

1974
DISTRIBUTION AND DENSITY OF BROWN BEAR DENING, KATMAI AREA, ALASK A.

U.S.D.I., NATL. PARK SERV., KATMAI NATL. MONUMENT, ALASKA. 15PP.

DEN SITE DEN CHAR

AKPN,AK ,KANM, ,

01176

TROYER, W.

1978
BROWN BEAR STUDIES - KATMAI.

U.S.D.I., NATL. PARK SERV., ANCHORAGE, ALASKA. 17PP.

CENSUS/TREND AGE/SEX MEAS/QUANT MOVE
MORT DATA

AKPN,AK ,KANM, ,

01177

TROYER, W.

1980A
MOVEMENTS AND DISPERSAL OF BROWN BEAR AT BROOKS RIVER, ALASKA.

U.S.D.I., NATL. PARK SERV., ALASKA AREA OFFICE, ANCHORAGE. 23 PP.

MOVE PRED RECR IMP

AKPN,AK ,KANM, ,BROO

01178

TROYER, W.

1980B
DISTRIBUTION AND DENSITIES OF BROWN BEAR ON VARIOUS STREAMS IN KA
TMAI NATIONAL MONUMENT.

U.S.D.I., NATL. PARK SERV., ALASKA AREA OFFICE, ANCHORAGE. 15 PP.

CENSUS/TREND PRED PRES DISTR

AKPN,AK ,KANM, ,

01179

TROYER, W. AND J.B. FARO.

1975
AERIAL SURVEY OF BROWN BEAR DENNING IN THE KATMAI AREA OF ALASKA.

PRES. AT NORTHWEST SECT. WILDL. SOC. MEET. 2-4 APR. 1975, ANCHORA
GE, ALASKA. 10PP.

DEN SITE DEN CHAR

AKPN,AK ,KANM, ,

01180

TROYER, W.A. AND R.J. HENSEL.

1962
CANNIBALISM IN BROWN BEAR.

ANIM. BEH. 10(3-4):231.

CANNIBAL

AKKA,AK ,KNWR, ,KOIS

01181

TROYER, W.A. AND R.J. HENSEL.

1964A
BEHAVIOR OF FEMALE BROWN BEARS UNDER STRESS.

J. MAMMAL. 45(3):488-489.

MATERNAL

AKKA,AK ,KNWR, ,KOIS

01182

TROYER, W.A. AND R.J. HENSEL.

1964B
STRUCTURE AND DISTRIBUTION OF A KODIAK BEAR POPULATION.

J. WILDL. MANAGE. 29(4):769-772.

AGE/SEX POP EST POP DENS CENSUS/TREND

AKKA,AK , , ,KOIS

01183

TROYER, W.A. AND R.J. HENSEL.

1969
THE BROWN BEAR OF KODIAK ISLAND.

U.S.D.I., BUR. OF SPORT FISH. AND WILDL., BRANCH OF WILDL. REFUGE
S. 233 PP.

MEAS/QUANT GEN DATA PCP BIOL MORT DATA
CENSUS/TREND GROW/DEV DEN REPRO
AGE/SEX
AKKA,AK , , ,KOIS

01184

TROYER, W.A., R.J. HENSEL AND K.E. DURLEY.

1962
LIVE TRAPPING AND HANDLING OF BROWN BEARS.

J. WILDL. MANAGE. 26(3):330-331.

CAPTURE

AKKA,AK ,KNWR, ,KARL

01185

TSCHANZ, VON B., M. MEYER-HOLZAPFEL AND S. BACHMANN.

1970
DAS INFORMATIONSSYSTEM BEI BRAUNBAREN. (ENGLISH SUMMARY).

ZEITSCHRIFT FUR TEIRPSYCHOLOGIE 27:47-72.

MARK

,GEN , , ,

01186

TULLAR, R.M.

1958
NEW RECORD OF CALIFORNIA GRIZZLY BEAR.

J. MAMMAL. 39(1):151-153

HIST DISTR

,CA , , ,

01187

TURNER, J. (CHAIRMAN).

1985A
THE GREAT BEAR IN OUR PARKS.

PREP. FOR THE SECRETARY OF THE INTERIOR. PREP. BY THE WILDL. COMM
. OF THE NATL. PARK ADVISORY BOARD. 14 PP.

	MGMT GEN	CONTROL	RELOC
RES MORT	NONMOT MGMT	PCL/ADM MGMT	

YGBE,IMW ,YNP , ,

01188

TURNER, J. (CHAIRMAN).

1985B
REPORT OF THE TASK FORCE.

MEMO. TO RESEARCH CHAIRMAN, INTERAGENCY GRIZZLY BEAR COMM. FROM G
RIZZLY BEAR TASK FORCE ON CLOSURES FOR GRIZZLY BEAR MANAGEMENT IN
YELLOWSTONE NATL. PARK. UNIV. MONT., MISSOULA. 4 PP.

CLOSURE

YGBE,IMW ,YNP , ,

C1189

U.S. BUREAU OF LAND MANAGEMENT.

1984
BIOLOGICAL ASSESSMENT FOR THE NORTH FORK EXPLORATORY OIL AND GAS WELL (MARATHON) ON THE SHOSHONE NATIONAL FOREST, CODY, WYOMING.

U.S.D.I., BUREAU OF LAND MANAGEMENT, WARLAND DISTRICT, WYO. 34 P P.

PRES DISTR ENERGY IMP

YGBE,WY ,SHNF, ,

C1190

U.S. DEPARTMENT OF AGRICULTURE.

1984
PROPOSED LEWIS AND CLARK NATIONAL FOREST PLAN.

U.S.D.A., FOREST SERV., LEWIS AND CLARK NATL. FOREST, GREAT FALLS , MONT.

MGMT PLAN

NCDE,MT ,LCNF, ,

01191

U.S. FISH AND WILDLIFE SERVICE.

1982A
GRIZZLY BEAR RECOVERY PLAN.

U.S.D.I., FISH AND WILDL. SERV., WASHINGTON, D.C.

MGMT PLAN	LEGAL	MCRT MGMT	LIVESTK MGMT
RECR MGMT	PRES DISTR	EDUC	TIMB MGMT
POP BIOL			

,US , , ,

01192

U.S. FISH AND WILDLIFE SERVICE.

1982B
ARCTIC NATIONAL WILDLIFE REFUGE COASTAL PLAIN RESOURCE ASSESSMENT : INITIAL REPORT BASELINE STUDY OF THE FISH, WILDLIFE, AND THEIR HABITS.

U.S.D.I., FISH AND WILDLIFE SERVICE, ARCTIC NATIONAL WILDLIFE, AL ASKA.

WEIGHT	POP DENS	HOME RNG	AGE/SEX
REP RATE	HAB USE	FOOD	DEN

ARC ,AK ,ANWR, ,

01193

U.S. FOREST SERVICE.

1980
ENVIRONMENTAL ASSESSMENT, PROSPECTING PERMIT APPLICATION, CONSOLI
CATED GEOREX GEOPHYSICS.

U.S.D.A., FOREST SERV., LEWIS AND CLARK NATL. FOREST, FLATHEAD NA
TL. FOREST, MONT. 87 PP.

ENERGY MGMT

NCDE,MT ,LCNF,FLNF,

01194

U.S. FOREST SERVICE.

1981
BEAR/LIVESTOCK MONITORING ON THE ASHTON RANGER DISTRICT, TARGHEE
NATIONAL FOREST.

U.S.D.A., FOREST SERV., TARGHEE NATL. FOREST, ST. ANTHONY, IDAHO.
15 PP.

DEPRED LIVESTK MGMT

YGBE,ID ,TANF, ,ASHT

01195

U.S. FOREST SERVICE.

1982
ENDANGERED THREATENED AND SENSITIVE PLANT AND ANIMAL SPECIES AND
THEIR HABITATS ON THE TARGHEE NATIONAL FOREST.

U.S.D.A., FOREST SERV., TARGHEE NATL. FOREST, ST. ANTHONY, IDEAHO
. 100 PP.

TYPE DESCRIP HAB USE FIRE MGMT TIMB MGMT
LIVESTK MGMT COVER ENERGY MGMT CUM EFF
RECR MGMT
YGBE,IDWY,TANF, ,

01196

U.S. FOREST SERVICE.

1983A
CABINET-YAAK ECOSYSTEM GRIZZLY BEAR DATA SHEET.

U.S.D.A., FOREST SERV. 5 PP.

RELOC

CYE ,IDMT, , ,

01197

U.S. FOREST SERVICE.

1983B
ZONING GUIDELINES FOR MANAGING GRIZZLY BEAR HABITAT IN NORTHERN I
DAHO.

U.S.D.A., FOREST SERV., IDAHO PANHANDLE NATL. FOREST, COEUR D'ALE
NE, IDAHO. 27 PP.

MGMT GEN	TIMB MGMT	FIRE MGMT	ROAD MGMT
LIVESTK MGMT	RECR MGMT	ENERGY MGMT	CONTROL

,ID ,IPNF, ,

01198

U.S. FOREST SERVICE.

1984A
GRIZZLY BEAR INITIATIVE, 1984-1988.

U.S.D.A., FOREST SERV., NORTHERN REGION. 9 PP.

MGMT GEN

,IDMT, , ,

01199

U.S. FOREST SERVICE.

1984B
FACILITATING GRIZZLY-HUMAN COEXISTENCE - AN INTEGRATED PROGRAM.

U.S.D.A., FOREST SERV., BRIDGER-TETON NATL. FOREST, JACKSON, WYO.
4 PP.

CAMP MGMT	EDUC	MGMT GEN

YGBE,WY ,BTNF, ,

01200

U.S. FOREST SERVICE.

1984C
THREATENED AND ENDANGERED SPECIES STATUS REPORT. KOOTENAI NATIONA
L FOREST - 1984.

U.S.D.A., FOREST SERV., KOOTENAI NATL. FOREST, MONT. 2 PP.

MGMT GEN	EDUC	MGMT GEN

,MT ,KONF, ,

01201

L.S. FOREST SERVICE.

1985A
GRIZZLY MANAGEMENT SITUATION GUIDELINES AND AUGMENTATION DISCUSSI
CN.

APPENDIX 8. IN: U.S.D.A., FOREST SERV. KOOTENAI NATIONAL FOREST P
ROPOSED FOREST PLAN. U.S.D.A., FCREST SERV., KOOTENAI NATL. FORES
T, LIBBY, MONT.

MGMT PLAN ZCNING TIMB MGMT FIRE MGMT
ROAD MGMT LIVESTK MGMT RECR MGMT GARB MGMT
POP AUG
CYNC,MT ,KONF, ,

01202

U.S. FOREST SERVICE.

1985B
GRIZZLY BEAR STANDARDS AND GUIDELINES.

APPENDIX G. IN: U.S.D.A., FOREST SERV. PROPOSED FOREST PLAN FOR G
ALLATIN NATIONAL FOREST. U.S.D.A., FOREST SERV., GALLATIN NATL. F
CREST, MONT.

ZONING TIMB MGMT FIRE MGMT LIVESTK MGMT
RECR MGMT GARB MGMT ENERGY MGMT CONTROL
MGMT PLAN
YGBE,MT ,GANF, ,

01203

U.S. FOREST SERVICE.

1985C
FLATHEAD NATIONAL FOREST PLAN: EIS VOL. 1 AND 2.

APPENDIX E. IN: U.S.D.A., FOREST SERVICE. FOREST PLAN: FLATHEAD N
ATIONAL FOREST. U.S.D.A., FOREST SERV., FLATHEAD NATL. FOREST, KA
LISPELL, MONT.

LIVESTK MGMT TIMB MGMT ROAD MGMT ENERGY MGMT
RECR MGMT MGMT GEN

NCDE,MT ,FLNF, ,

01204

U.S. FOREST SERVICE.

1985D
KEY FOR GRIZZLY BEAR COMPONENTS OF THE NORTHERN ECOSYSTEMS.

U.S.D.A., FOREST SERV. 23 PP.

MAP/TYPE

,IDMT,USFS, ,

01205

U.S. FOREST SERVICE.

1985E
FOREST SERVICE GRIZZLY BEAR MANAGEMENT POLICY RECOMMENDATIONS, AU
GUST 1985.

U.S.D.A., FOREST SERV. 18 PP.

MGMT GEN   ZONING   MAP/TYPE   MORT MGMT
LIVESTK MGMT   FIRE MGMT   NONMOT MGMT   ENERGY MGMT
TIMB MGMT
,US ,USFS, ,

01206

U.S. FOREST SERVICE.

1985F
LAND MANAGEMENT PLAN FOR THE TARGHEE NATIONAL FOREST.

U.S.D.A., FOREST SERV., TARGHEE NATL. FOREST, ST. ANTHONY, IDAHO.
711 PP.

MGMT PLAN   ZONING   TIMB MGMT   MGMT GEN

YGBE,IDWY,TANF, ,

01207

U.S. FOREST SERVICE.

1985G
GRIZZLY BEAR SITUATION AND MANAGMENT GUIDELINES.

APPENDIX D. IN: U.S.D.A., FOREST SERV., KOOTENAI NATIONAL FOREST
DRAFT ENVIRONMENTAL IMPACT STATEMENT. U.S.D.A., FOREST SERV., KOO
TENAI NATL. FOREST, LIBBY, MONT.

PRES DISTR   ZONING   MGMT GEN   POP AUG
TIMB MGMT   FIRE MGMT   LIVESTK MGMT   RECR MGMT
CAMP MGMT
CYNC,MT ,KONF, ,

01208

U.S. FOREST SERVICE.

1985H
THREATENED AND ENDANGERED SPECIES - GRIZZLY BEAR ("GRIZZLY BEAR G
UIDELINES").

APPENDIX E. IN: U.S.D.A., FOREST SERV. FOREST PLAN: FLATHEAD NATI
ONAL FOREST. U.S.D.A., FOREST SERV., FLATHEAD NATL. FOREST, KALIS
PELL, MONT.

MGMT PLAN   ZONING   FIRE MGMT   TIMB MGMT
LIVESTK MGMT   RECR MGMT   ENERGY MGMT

NCDE,MT ,FLNF, ,

01209

U.S. FOREST SERVICE.

1985I
GRIZZLY BEAR.

PP. 60-93 IN: THREATENED, ENDANGERED AND SENSITIVE PLANTS AND ANI
MAL SPECIES AND THEIR HABITATS IN THE BRIDGER-TETON NATIONAL FORE
ST, U.S.D.A., FOREST SERV., JACKSON, WYO.

HAB USE	FOOD	MGMT GEN	TIMB-METH
LIVESTK MGMT		RECR MGMT	COVER

YGBE,WY ,BTNF, ,

01210

U.S. FOREST SERVICE.

1985J
MANAGEMENT AREA PRESCRIPTION 7.

APPENDIX IV, PP. 187-206 IN: U.S. FCREST SERV., 1985. LAND AND RE
SOURCE MANAGMENT PLAN FOR THE BRIDGER-TETON NATIONAL FOREST. U.S.
D.A., FOREST SERV., JACKSON, WYO.

TIMB-METH	TIMB-POST	TIMB-HAB	ROAD MGMT
VEG SUCC	RECR MGMT	LIVESTK MGMT	FIRE MGMT

YGBE,WY ,BTNF, ,

01211

U.S. FOREST SERVICE.

1986
LOLO NATIONAL FOREST PLAN ENVIRONMENTAL IMPACT STATEMENT.

U.S.D.A. FOREST SERV., LOLO NATL. FOREST, MISSOULA, MONT.

ZONING	TIMB MGMT	MGMT GEN

CYNC,MT ,LONF, ,

01212

U.S. FOREST SERVICE, MONTANA FISH, WILDLIFE AND PARKS, BUREAU OF LA
ND MANAGEMENT AND U.S. FISH AND WILDLIFE SERVICE.
1986
CUMULATIVE EFFECTS ANALYSIS PROCESS FOR THE ROCKY MOUNTAIN FRONT
NORTHERN CONTINENTAL DIVIDE GRIZZLY BEAR ECOSYSTEM.

DRAFT REPORT. 36 PP.

CUM EFF	HAB EFFECT	HUMAN IMP	MAP/TYPE

NCDE,MT ,USFS,BLM ,RMEF

01213

U.S. FOREST SERVICE AND BUREAU OF LAND MANAGEMENT.

1985
ENVIRONMENTAL ASSESSMENT ON HALL CREEK APPLICATION FOR PERMIT TO DRILL BY AMERICAN PETROFINA COMPANY OF TEXAS.

U.S.D.A., FOREST SERV., LEWIS AND CLARK NATL. FOREST, GREAT FALLS, MONT.

ENERGY IMP   ENERGY MGMT   ROAD MGMT

NCDE,MT ,USFS,BLM ,RMEF

01214

U.S. FOREST SERVICE AND U.S. NATIONAL PARK SERVICE.

1985
GREATER YELLOWSTONE AREA OUTFITTER POLICY.

U.S.D.I., NATL. PARK SERVICE AND U.S.D.A., FOREST SERV. 37 PP.

OUTFIT MGMT   IDENT/RECOG   CAMP MGMT   AVOID/ATTRAC
CLOSURE   HARV MGMT

YGBE,IMW , , ,

01215

VALKENBURG, P.

1976
A STUDY OF THE BROWN BEAR (URSUS ARCTOS) IN THE PROPOSED NORTHEASTERN ADDITION TO MOUNT MCKINLEY NATIONAL PARK.

M.S. THESIS, UNIV. ALASKA, FAIRBANKS. 86 PP.

HARV DATA   FOOD   PRED   DEN
MAP/TYPE   PRES DISTR   MOVE   MEAS/QUANT
MARK
AK-I,AK ,DENP, ,

01216

VAN DRIMMELEN, B.

1985
GRIZZLY BEAR MANAGEMENT PLAN FOR SKEENA REGION.

B.C. FISH AND WILDL. BRANCH, CRANBROOK. 20 PP.

POP DENS   POP EST   HARV MGMT   POACH/ILLEG
HARV DATA   ZONING   HARV IMP

BC-C,BC , , ,SKEE

01217

VAN HORN, J. AND J. DALLE-MOLLE.

1983
DENALI BEAR-HUMAN CONFLICT MANAGEMENT, 1983.

U.S.D.I., NATL. PARK SERV., DENALI NATL. PARK AND PRESERVE, ALASK
A. 17 PP.

NONMOTOR IMP	GARBAGE	GARB MGMT	POP DENS
NONMOT MGMT	MOTOR MGMT	HUMAN INJ	DEPRED
REACTION			

AK-I,AK ,DENP, ,

01218

VAN HORN, J. AND J. DALLE-MOLLE.

1984
DENALI BEAR-HUMAN CONFLICT MANAGEMENT, 1984.

U.S.D.I., NATL. PARK SERV., DENALI NATL. PARK AND PRESERVE, ALASK
A. 22 PP.

MOTOR IMP	MOTOR MGMT	NONMOT MGMT	GARB MGMT
GARBAGE	REACTION	HUMAN INJ	DEPRED

AK-I,AK ,DENP, ,

01219

VAN KEULEN-KROMHOUT, G.

1978
ZOO ENCLOSURES FOR BEARS. URSIDAE: THEIR INFLUENCE ON CAPTIVE BEH
AVIOUR AND REPRODUCTION.

INT. ZOO YEARB. 18:177-186.

ZOO TECH

,GEN , , ,

01220

VARNEY, J.R., J.J. CRAIGHEAD AND J.S. SUMNER.

1974
AN EVALUATION OF THE USE OF ERTS-1 SATELLITE IMAGERY FOR GRIZZLY
BEAR HABITAT ANALYSIS.

PROC. SYMP. 3RD. EARTH RESOUR. TECH. SATELLITE 1:1653-1669.

MAP/TYPE

NCDE,MT ,USFS, ,LSWA

01221

VARNEY, J.R., J.J. CRAIGHEAD AND J.S. SUMNER.

1976
AN EVALUATION OF THE USE OF ERTS-1 SATELLITE IMAGERY FOR GRIZZLY BEAR HABITAT ANALYSIS.

INT. CONF. BEAR RES. AND MANAGE. 3:261-273.

HAB ANAL MAP/TYPE

NCDE,MT ,LONF, ,LSWA

01222

VIERECK, L.A., C.T. DYRNESS AND A.R. BATTEN.

1982
REVISION OF PRELIMINARY CLASSIFICATIONS FOR VEGETATION OF ALASKA.

U.S.D.A., FOREST SERV., FAIRBANKS, AK. UNPUBL. RER., INST. NO. FORESTRY. 72 PP.

HAB ANAL VEG SUCC

,AK , , ,

01223

VROOM, G.W., S. HERRERO AND R.T. OGILVIE.

1980
THE ECOLOGY OF WINTER DEN SITES OF GRIZZLY BEARS IN BANFF NATIONAL PARK, ALBERTA.

INT. CONF. BEAR RES. AND MANAGE. 4:321-330.

DEN DEN CHRON DEN CHAR DEN SITE

CR ,AT ,BANP, ,

01224

WALKER, E.P., R.M. NOWAK AND J.L. PARADISO.

1983
WALKER'S MAMMALS OF THE WORLD, VOL. II.

JOHNS HOPKINS UNIV. PRESS, BALTIMORE, MD. 1362 PP.

TAXON/EVOL MORPH/PHYS GEN BIOL DISTR

,GEN , , ,

01225

WALLACH, J.

1978
URSIDAE.

CHAPTER 26. PP. 628-706 IN: M.E. FOWLER, ED. ZOO AND WILD ANIMAL MEDICINE. W.B. SAUNDERS CO., PHILADELPHA, PA.

ZOO TECH PARAS/DIS DENT REPRO PHYS

,GEN , , ,

01226

WALLACH, J.D., R. FRUEH AND M. LENTZ.

1967
THE USE OF M.99 AS AN IMMOBILIZING AND ANALGESIC AGENT IN CAPTIVE WILD ANIMALS.

J. AM. VET. MED. ASSOC. 151(7):870-876.

DRUGS ZOO TECH

,GEN , , ,

01227

WALSBERG, G.E.

1983
COAT COLOR AND SOLAR HEAT GAIN IN ANIMALS.

BIOSCIENCE 33(2):88-91.

PELAGE HAIR TEMP

,GEN , , ,

01228

WARNER, S.

IN PRESS
VISITOR IMPACT ON BROWN BEARS, ADMIRALTY ISLAND, ALASKA.

INT. CONF. BEAR RES. AND MANAGE. 7.

NONMOTOR IMP ACT PATT REACTION

AKSE,AK ,AINM, ,PACR

01229

WASER, P.M. AND W.T. JONES.

1983
NATAL PHILOPATRY AMONG SOLITARY MAMMALS.

QUART. REV. BIOL. 58:355-390.

INTRASP BEH MATERNAL MOVE

,GEN , , ,

01230

WATSON, G.W.

1955
CARIBOU MOVEMENTS, ABUNDANCE AND DISTRIBUTION.

FED. AID WILDL. REST. PROJ. W-3-R-9, JOB NO. 1, WORK PLAN B. ALAS
KA GAME COMMISSION, JUNEAU. 4 PP.

PRED

AK-I,AK , , ,NESU

01231

WATTS, P.D., N.A. ORITSLAND, C. JONKEL AND K. RONALD.

1981
MAMMALIAN HIBERNATION AND THE OXYGEN CONSUMPTION OF A DENNING BLA
CK BEAR (URSUS AMERICANUS).

COMP. BIOCHEM. PHYSIOL. 69(1):121-123.

HIB PHYS

,GEN , , ,

01232

WEAVER, J.

1986
CHARTING THE COURSE, THE FOREST SERVICE GRIZZLY BEAR CONSERVATION
PROGRAM.

U.S.D.A., FOREST SERV. 79 PP.

MGMT GEN MGMT PLAN

,US , , ,

01233

WEAVER, J., R. ESCANO, D. MATTSON, T. PUCHLERZ AND D. DESPAIN.

1985
CUMULATIVE EFFECTS ANALYSIS PROCESS FOR THE YELLOWSTONE ECOSYSTEM . (DRAFT).

U.S.D.A., FOREST SERV. AND U.S.D.I., NATL. PARK SERV., INTERAGENCY GRIZZLY BEAR STUDY TEAM, UNIV. MONT., MISSOULA. 40 PP.

CUM EFF MOTOR IMP NCNMOTOR IMP HAB EFFECT HUMAN IMP

YGBE,IMW , , ,

01234

WEAVER, J., R. ESCANO, D. MATTSON, T. PUCHLERZ AND D. DESPAIN.

1986
A CUMULATIVE EFFECTS MODEL FOR GRIZZLY BEAR MANAGEMENT IN THE YELLOWSTONE ECOSYSTEM.

PP. 234-246 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

CUM EFF MOTOR IMP NONMOTOR IMP HAB EFFECT HUMAN IMP

YGBE,IMW , , ,

01235

WECKWORTH, R.P., K. KONCCHE AND J. CROSS.

1975
BIG GAME SURVEY AND INVENTORY.

FED. AID WILDL. REST. PROJ. W-130-R-6, JOB NO. I-1. JOB COMPLETION REP., JULY 1, 1974-JUNE 30, 1975. MONT. DEP. FISH AND GAME, HELENA. 28 PP.

HARV DATA AGE/SEX RELOC

NCDE,MT , , ,

01236

WEEDEN, R.B.

1971
OIL AND WILDLIFE: A BIOLOGIST'S VIEW.

TRANS NORTH AM. WILDL. AND NAT. RESOUR. CONF. 36:242-251.

ENERGY IMP

,AK , , ,

01237

WELSH, C.J. AND H.D. PICTON.

1984
AN INVESTIGATION OF GRIZZLY AND BLACK BEAR SCAT SEPARATION USING BILE ACIDS.

FINAL REP. PREP. FOR NATL. PARK SERV., ORDER NO. PX 1200-3-C423. PREP. BY MONT. STATE UNIV., BOZEMAN. 11 PP.

SCAT ANAL IDENT/RECOG

,GEN , , ,

01238

WERNER, T., D. GILLESPIE AND C. JONKEL.

1978
GRIZZLY AND BLACK BEAR DENS IN THE BORDER GRIZZLY AREA.

PP. 173-214 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. ANNU. REP. NO. 3.

DEN SITE DEN CHAR DEN CHRON

NCDE,MT , , ,

01239

WERNER, T. AND C. JONKEL.

1977
GRIZZLY DENS IN THE BORDER GRIZZLY AREA.

PP. 3-11 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. ANNU. REP. NO. 2.

DEN SITE

NCDE,MT , , ,

01240

WHITE, T.

1965
THE POSSIBILITY OF GRIZZLY BEARS STILL EXISTING IN SASKATCHEWAN.

BLUE JAY 23:136-140.

HIST DISTR

,SK , , ,

01241

WHITLOCK, B.

1979
SEASONAL USE OF OVABAN AS A MEANS OF CONTRACEPTION IN THE KODIAK BEAR.

ANN. PROC. AM. ASSOC. ZOO VET. 1978:179-1980.

REPRO PHYS ZOO TECH

,GEN , , ,

01242

WIELGUS, R.B.

1986
HABITAT ECOLOGY OF THE GRIZZLY BEAR IN THE SOUTHERN ROCKY MOUNTAI NS OF CANADA.

M.S. THESIS, UNIV. IDAHO, MOSCOW. 136 PP.

HAB USE HAB EFFECT FOOD HAB ANAL
HOME RNG MOVE INTRASP BEH DEN
PRED
CR ,ATBC, , ,KANA

01243

WIMSATT, W.A.

1963
DELAYED IMPLANTATION IN THE URSIDAE, WITH PARTICULAR REFERENCE TO THE BLACK BEAR (URSUS AMERICANUS PALLAS).

PP. 49-76 IN: DELAYED IMPLANTATION. UNIV. CHICAGO PRESS, CHICAGO. 318 PP.

REPRO PHYS

,GEN , , ,

01244

WINN, D.S. AND K.R. BARBER.

1986
CARTOGRAPHIC MOLDING: A METHOD OF CUMULATIVE EFFECTS APPRAISAL.

PP. 247-252 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

MAP/TYPE CUM EFF

YGBE,IMW , , ,

01245

WINTER, K.

1969
BIG GAME SURVEY. GRIZZLY BEAR STUDY.

FED. AID WILDL. REST. PROJ. W-027-R-23, JOB NO. 4. WYO. GAME AND FISH COMM., CHEYENNE.

CENSUS METH HARV DATA

YGBE,WY ,SHNF,BTNF,

01246

WOLFE, J.R.

1983
ELECTROPHORETIC DIFFERENTIATION BETWEEN ALASKAN BROWN AND BLACK BEARS.

J. WILDL. MANAGE. 47(1):268-271.

IDENT/RECOG

,GEN , , ,

01247

WOLFE, R.R., R.A. NELSON, T.P. STEIN, L. ROGERS AND M.A. WOLFE.

1982
UREA NITROGEN REUTILIZATION IN HIBERNATING BEARS.

FED. PROC. 41(5):1623.

HIB PHYS

,GEN , , ,

01248

WOOD, K.H.

1985A
1985 IMPLEMENTATION PLAN: IMPLEMENTING THE INFORMATION AND FACILITIES PROGRAM TO MANAGE RECREATION USE IN GRIZZLY HABITAT.

U.S.D.A., FOREST SERV., ROCKY MOUNTAIN REGION, SHOSHONE NATL. FOREST, WYO. 39 PP.

MGMT GEN CAMP MGMT OUTFIT MGMT

YGBE,WY ,SHNF, ,

01249

WOOD, K.H.

1985B
1984 ENVIRONMENTAL ASSESSMENT. MANAGING RECREATION USE IN GRIZZLY HABITAT.

APPENDIX F IN: K.H. WOOD. 1985 IMPLEMENTATION PLAN. IMPLEMENTING THE INFORMATION AND FACILTIES PROGRAM TO MANAGE RECREATION USE IN GRIZZLY HABITAT. U.S.D.A., FOREST SERV., SHOSHONE NATL. FOREST, WYO. 45 PP.

MGMT GEN	ZONING	EDUC	MGMT PLAN
CAMP MGMT	NONMOT MGMT	CLOSURE	OUTFIT MGMT
MORT MGMT			

YGBE,WY ,SHNF, ,

01250

WOOD, M. AND A. OLSEN.

1984A
WILDLIFE IMPACT ASSESSMENT AND SUMMARY OF PREVIOUS MITIGATION RELATED TO HYDROELECTRIC PROJECTS IN MONTANA, VOLUME 2A - CLARK FORK PROJECTS: THOMPSON FALLS DAM.

FINAL REP. MONT. DEP. FISH, WILDL. AND PARKS, HELENA.

ENERGY IMP

CYE ,MT , , ,CLAR

01251

WOOD, M. AND A. OLSEN.

1984B
WILDLIFE IMPACT ASSESSMENT AND SUMMARY OF PREVIOUS MITIGATION RELATED TO HYDROELECTRIC PROJECTS IN MONTANA, VOLUME 2B - CLARK FORK RIVER PROJECTS: CABINET GORGE AND NOXON RAPIDS DAMS.

FINAL REP. MONT. DEP. FISH, WILDL. AND PARKS, HELENA.

ENERGY IMP

CYE ,MT , , ,CLAR

01252

WOOD, R.E.

1973
SOUTHEASTERN BROWN BEAR STUDIES.

FED. AID WILD. REST. PROJ. W-17-4, JOB 4.5R. FINAL REP. ALASKA DEP. FISH AND GAME, JUNEAU. 4 PP.

LENGTH	WEIGHT	GIRTH	SKULL
AGE/SEX	CAPTURE		

AKSE,AK , , ,ADIS

01253

WOOD, R.E.

1974
SOUTHEASTERN BROWN BEAR STUDIES.

FED. AID WILD. REST. PROJ. W-17-5, JOB 4.7R. PROG. REP., VOL II.
ALASKA DEP. FISH AND GAME, JUNEAU. 4 PP.

LITR SIZE AGE/SEX POP EST

AKSE,AK , , ,ADIS

01254

WOOD, R.E.

1975
SOUTHEASTERN BROWN BEAR STUDIES.

FED. AID WILD. REST. PROJ. W-17-6, JOB 4.7R. PROG. REP., VOL II.
ALASKA DEP. FISH AND GAME, JUNEAU. 4 PP.

MOVE POP EST AGE/SEX WEIGHT

AKSE,AK , , ,ADIS

01255

WOOD, R.E.

1976
MOVEMENT AND POPULATIONS OF BROWN BEARS IN THE HOOD BAY DRAINAGE
OF ADMIRALTY ISLAND.

FED. AID WILDL. REST. PROJ. W-17-5, W-17-6, AND W-17-7, JOB 4.7R.
FINAL REP., JULY 1, 1972- JUNE 30, 1975. ALASKA DEP. FISH AND GA
ME, JUNEAU. 10 PP.

CENSUS/TREND MOVE AGE/SEX WEIGHT

AKSE,AK , , ,ADIS

01256

WOODS, R. AND D. HEBERT.

1983
PRELIMINARY ANALYSIS OF HARVEST DATA FOR COASTAL BEAR POPULATIONS
IN REGION V.

B.C. WILDL. BRANCH, VICTORIA. 26 PP.

HARV DATA AGE/SEX POP DENS HARV IMP
HARV MGMT

BC-C,BC , , ,

01257

WOOLDRIDGE, D.R.

1978
A FIELD AND CAPTIVE STUDY OF REPELLENCY AND INDUCED AVERSION TECH NQIUES ON 3 FAMILIES OF VERTEBRATE PESTS: URSIDAE, CANIDAE AND CE RVIDAE.

M.S. THESIS. SIMON FRASER UNIV., BURNABY, B.C.

DETER/REPEL

,GEN , , ,

01258

WOOLDRIDGE, D.R.

1980
CHEMICAL AVERSION CONDITIONING OF POLAR AND BLACK BEARS.

INT. CONF. BEAR RES. AND MANAGE. 4:167-173.

AVER COND

,GEN , , ,

01259

WOOLDRIDGE, D.R.

1983
POLAR BEAR ELECTRONIC DETERRENT AND DETECTION SYSTEMS.

INT. CONF. BEAR RES. AND MANAGE. 5:264-269.

DETER/REPEL

,GEN , , ,

01260

WOOLDRIDGE, D.R.

1984
THE "FERRET" 12 GAUGE SOFT-SLUG AS A BLACK BEAR DETERRENT.

PRES. AT PREDATOR SYMP. 23 MARCH, 1984, MISSOULA, MONT.

DETER/REPEL

,GEN , , ,

01261

WOOLDRIDGE, D.R. AND P. BELTON.

1980
NATURAL AND SYNTHESIZED AGGRESSIVE SOUNDS AS POLAR BEAR REPELLENT
S.

INT. CONF. BEAR RES. AND MANAGE. 4:85-91.

DETER/REPEL

,GEN , , ,

01262

WOOLEY, D.R.

1976
TERRESTRIAL MAMMAL STUDIES ALONG THE CROSS DELTA PIPELINE ROUTE,
1975.

CHAPTER 3 IN: R.D. JAKIMCHUK, ED. STUDIES OF MAMMALS ALONG THE PR
OPOSED MACKENZIE VALLEY GAS PIPELINE ROUTE, 1975. ARCTIC GAS BIOL
. REP. SER., VOL. 36.

PRES DISTR

CARC,NWYK, , ,

01263

WORLEY, D.E., J.C. FOX, J.B. WINTERS, R.H. JACOBSON AND K.R. GREER.

1976
HELMINTH AND ARTHROPOD PARASITES OF GRIZZLY AND BLACK BEARS IN MO
NTANA AND ADJACENT AREAS.

INT. CONF. BEAR RES. AND MANAGE. 3:455-464.

PARAS/DIS

,MT , , ,

01264

WORLEY, D.E., K.R. GREER AND D. PALMISCIANO.

1983
POSSIBLE RELATIONSHIPS BETWEEN TRICHINELLOSIS AND ABNORMAL BEHAVI
OR IN BEARS.

INT. CONF. BEAR RES. AND MANAGE. 5:280-283.

PARAS/DIS

,MTWY, , ,

01265

WRAY, D. AND D. HEBERT.

1975
PRELIMINARY INVESTIGATIONS OF THE ECOLOGY OF THE COASTAL GRIZZLY BEAR IN THE AHNUHATI RIVER - KNIGHT INLET.

BRITISH COLUMBIA, WILDLIFE BRANCH, VICTORIA. 80 PP.

POP EST AGON CAPTURE RELOC MISC QUANT

BC-C,BC , , ,AHNU

01266

WRIGHT, W.H.

1909
THE GRIZZLY BEAR.

UNIV. NEBRASKA PRESS, LINCOLN. 274 PP.

HIST ACCT GEN BIOL

,GEN , , ,

01267

WYNNK, W.P. AND J.R. GUNSON.

1977
DESIGN AND EFFECTIVENESS OF A PORTABLE ELECTRIC FENCE FOR APIARIES.

ALBERTA FISH AND WILDL. DIV., EDMONTON. 11 PP.

DETER/REPEL

,AT , , ,

01268

YDE, C.A. AND A. OLSEN.

1984
WILDLIFE IMPACT ASSESSMENT AND SUMMARY OF PREVIOUS MITIGATION RELATED TO HYDROELECTRIC PROJECTS IN MONTANA, VOLUME 1: LIBBY DAM PROJECT.

FINAL REP. PREP. BY MONT. DEP. FISH, WILDL. AND PARKS, HELENA. PREP. BY BONNEVILLE POWER ADMINISTRATION, PROJ. NO. 83-464.

ENERGY IMP

CYE ,MT , , ,KOOC

C1269

YOUNG, D.L.

1986
CUMULATIVE EFFECTS ANALYSIS OF GRIZZLY BEAR HABITAT ON THE LEWIS AND CLARK NATIONAL FOREST.

PP. 217-221 IN: G.P. CONTRERAS AND K.E. EVANS, EDS. PROCEEDINGS-GRIZZLY BEAR HABITAT SYMPOSIUM. U.S.D.A., FOREST SERV. INTERMOUNTAIN RES. STAT., OGDEN, UTAH. GEN. TECH. REP. INT-207.

CUM EFF

NCDE,MT ,LCNF, ,

C1270

YOUNG, B.F. AND R.L. RUFF.

1982
POPULATION DYNAMICS AND MOVEMENTS OF BLACK BEARS IN EAST CENTRAL ALBERTA.

J. WILDL. MANAGE. 46(4):845-860.

INTRASP BEH AGON PCP REG

,GEN , , ,

01271

YUKON DEP. RENEWABLE RESOUR.

1983
YUKON'S ARCTIC BEARS - AVOIDING PROBLEMS WITH POLAR BEARS AND GRIZZLIES NORTH OF TREELINE. (DRAFT).

YUKON WILDL. BRANCH, WHITEHORSE. 25 PP.

DETER/REPEL CAMP MGMT

NINT,YK , , ,

01272

YUKON DEP. RENEWABLE RESOURCES.

1984
CURRENT MANAGEMENT OF UNGULATES AND THEIR PREDATORS IN THE YUKON TERRITORY.

YUKON RENEWABLE RESOURCES, WHITEHOUSE. 31 PP.

PRED CONTROL INTERSP COMP MGMT GEN
HARV MGMT

,YK , , ,

01273

YUKON DEP. RENEWABLE RESOURCES.

1986
YUKON HUNTING REGULATIONS SYNOPSIS.

YUKON RENEWABLE RES.

HARV MGMT

,YK , , ,

01274

ZAGER, P.E.

1980A
THE INFLUENCE OF LOGGING AND WILDFIRE ON GRIZZLY BEAR HABITAT IN NORTHWESTERN MONTANA.

PH.D. DISS. UNIV. MONT., MISSOULA. 131 PP.

TIMB IMP　　ROAD IMP　　CUT USE　　BURN USE/MGT
FIRE MGMT　　TIMB-POST　　TIMB-METH　　TIMB-HAB
ROAD MGMT
NCDE,MT ,FLNF, ,NFLT

01275

ZAGER, P.E.

1980B
GRIZZLY BEAR HABITAT UTILIZATION.

PP. 99-132 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ. , UNIV. MONT., MISSOULA. ANNUAL REP. NO. 5.

TIMB USE　　MAP/TYPE　　HAB USE　　FOOD
MOVE　　ROAD IMP　　TIMB MGMT　　TIMB-METH
CUT USE
NCDE,MT , , ,

01276

ZAGER, P.

1981
NORTHERN SELKIRK MOUNTAINS GRIZZLY BEAR HABITAT SURVEY, 1981.

U.S.D.A., FOREST SERV., IDAHO PANHANDLE NATL. FORESTS CONTRACT. 75 PP.

HAB RECON　　MAP/TYPE　　PRES DISTR　　TIMB-METH
ROAD MGMT　　ZONING　　CUT USE　　HAB USE

SME ,IDWA, , ,

01277

ZAGER, P.

1983
GRIZZLY BEARS IN IDEAHO'S SELKIRK MOUNTAINS: AN UPDATE.

NORTHWEST SCI. 57(4):299-309.

PRES DISTR FOOD HAB RECON HAB USE

SME ,ID , , ,

01278

ZAGER, P. AND C. JONKEL.

1979
GRIZZLY BEAR-WILDFIRE-LOGGING RELATIONSHIPS IN NORTHWESTERN MONTA
NA - A PROGRESS REPORT.

PP. 78-105 IN: C. JONKEL, ED. ANNUAL REPORT. BORDER GRIZZLY PROJ.
, UNIV. MONT., MISSOULA.

VEG SUCC BURN USE/MGT CUT USE TIMB-METH
TIMB-POST

NCDE,MT , , ,

01279

ZAGER, P. AND C. JONKEL.

1980
MANAGEMENT GUIDELINES FOR OCCUPIED GRIZZLY BEAR HABITAT IN NORTHW
ESTERN MONTANA.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 51. 1
7 PP.

HAB USE TIMB MGMT TIMB-POST ROAD MGMT
ENERGY MGMT LIVESTK MGMT SUBDIV MGMT RECR MGMT

NCDE,MT , , ,

01280

ZAGER, P.E. AND C.J. JONKEL.

1983
MANAGING GRIZZLY BEAR HABITAT IN THE NORTHERN ROCKY MOUNTAINS.

J. FORESTRY 81(8):524-526.

HAB USE TIMB MGMT ROAD MGMT TIMB-METH
ENERGY MGMT LIVESTK MGMT

NCDE,MT , , ,

01281

ZAGER, P., C. JONKEL AND J. HABECK.

1983
LOGGING AND WILDFIRE INFLUENCE ON GRIZZLY BEAR HABITAT IN NORTHWE
STERN MONTANA.

INT. CONF. BEAR RES. AND MANAGE. 5:124-132.

BURN USE/MGT FIRE MGMT VEG SUCC TIMB-METH
TIMB-POST TIMB IMP CUT USE ROAD IMP

NCDE,MT ,FLNF, ,

01282

ZAGER, P., C. JONKEL AND R. MACE.

1980
GRIZZLY BEAR HABITAT TERMINOLOGY.

BORDER GRIZZLY PROJ., UNIV. MONT., MISSOULA. SPEC. REP. NO. 41. 1
5 PP.

HAB SAMPL MAP/TYPE

,GEN , , ,

01283

ZARNKE, R.L.

1981
SEROLOGIC SURVEY FOR SELECTED MICROBIAL AGENTS IN MAMMALS FROM AL
BERTA, 1976.

J. WILDL. DIS. 17(3):453-461.

PARAS/DIS

,AT , , ,

01284

ZARNKE, R.L.

1983
SEROLOGIC SURVEY FOR SELECTED MICROBIAL PATHOGENS IN ALASKAN WILD
LIFE.

J. WILDL. DIS. 19(4):324-329.

PARAS/DIS

,AK , , ,

APENDIX E
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PUBLIC ATTITUDES
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APENDIX F

GEOGRAPHIC INDEX (SORTED BY INDIVIDUAL GEOGRAPHIC KEYWORD

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CLAR

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CLCR

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CLNF

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CYPR

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DENP

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ELLK

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HUNG

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JDR
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JIML
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KGPP
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WHIL

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APPENDIX G

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ATSA CYPR
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00846 00849 00853 00858 00882 00883 00884 00885 00886 00887
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IMW
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MNTB
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NWT THGS
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SWMX
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US
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01069 01070 01071 01191 01232

US NPS
01104

US USFS
01205

WA
00501 00502 00503 00659

WY
00657

YK
00153 00442 00694 00695 01089 01101 01102 01103 01108 01272
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YK YUKR
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AK-I AK
00094 00104 00247 00349 00546 00620 00686 00758 00759

AK-I AK AKRG
00983 00988 00990

AK-I AK COPR
00141 01124

AK-I AK JIML
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AK-I AK MCNE
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AK-I AK NESU
00260 01230

AK-I AK NSLP
00230

AK-I AK PRWM
00952

AK-I AK STEE
00903 00904 01097

AK-I AK ANWR
00101 00102

AK-I AK DENP
00134 00135 00234 00235 00236 00237 00246 00250 00251 00253
00267 00577 00578 00856 00865 01093 01094 01121 01151 01169
01215 01217 01218

AKKA AK
00278

AKKA AK KARL
00163 00166 00655 01088

AKKA AK KOIS
00165 01182 01183

AKKA AK TERL
01106 01107

AKKA AK KARL KOIS
00346

AKKA AK KNWR
00065 00066 00078 00680

AKKA AK KNWR KARL
00077 01174 01184

AKKA AK KNWR KOIS
00034 00164 01180 01181

AKKA AK KNWR TERL
00483 01114

AKPN AK
00045 00149 00285 00286 00287 00366 00369 00484 00673 00963

AKPN AK AMER
00290

AKPN AK BLKL
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AKPN AK CHIG
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AKPN AK KENA
00079 00333 00334 00335 00336 00358 00881

AKPN AK MCNE
00275 00297

AKPN AK KANM
00021 00022 00169 00580 00869 01164 01165 01175 01176 01178
01179

AKPN AK KANM BROO
00070 00248 01177

AKPN AK KNWR KOIS
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AKPN AK MCGS MCNE
00276 00305 00367 00698 01131 01133

AKSC AK COPR
00140

AKSC AK NESU
00050 00051 00052 00053 00054 00055 00056 00057 00058 00060
00061 00825 00826 00827 00828 00829 00830 00831 00832 00834
01117 01118

AKSE AK
00617 00807 00902

AKSE AK ABC
00618 01052 01054

AKSE AK ADIS
00545 00619 00679 00765 01049 01051 01053 01055 01252 01253
01254 01255

AKSE AK AINM PACR
00956 01228

AKSE AK TONF
00933 00934

AKSE AK TONF ADIS
00935

ARC AK
00506 00965

ARC AK BRKR
00875 00876 00877 00981 01047

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ARC  AK              EBRK
     00232 00688 00721 00766 00959 00960 00978 00979 00985

ARC  AK              NESU
     00059

ARC  AK              NSLP
     00229

ARC  AK              WBRK
     00242 00243 00351 00982 00987 00989 00991

ARC  AK         WBRK BRKR
     00984

ARC  AK   ANWR
     00347 00940 00941 00942 01192

ARC  AK   BROO
     00967

ARC  AK   NPR        BRKR
     00992

ARC  AK   NPR        WBRK
     00477 00478 00479 00980 00986

BC-C BC
     00025 00029 00274 00324 00476 00690 01256

BC-C BC              AHNU
     00692 01024 01099 01265

BC-C BC              KIMS
     00026 00027 00028 00063 00438 00439 00440 00441

BC-C BC              NAKR
     00806

BC-C BC              SKEE
     01216

BC-I BC              REVL
     01091

BC-I BC   CGNP
     00422 00437 00848 00850 00851 00852

BC-I BC   KGNP VAPP
     00775

BC-I BC   REVL
     00421
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BC-I BC    SPPP
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BORF AT                SWHI
     00860 00924

BORF NWT               SIMP
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CARC NWT               RICH
     00445 00446 00927 01098

CARC NWT               TUKP
     00862

CARC NWYK
     01262

CARC YK
     00261 00612 00861 01028

CARC YK                BARN
     00925

CR   AT
     00517 00773

CR   AT                KANA
     00770 00771 00772 00774

CR   AT                SWAP
     00519 00520 00521 00961

CR   AT    ATPP
     00006

CR   AT    BANP
     00427 00435 00897 00975 01223

CR   AT    BANP        CASC
     00191 00423 00424 00425 00426 00433 00434 00436 00901 01167

CR   AT    BANP        CUWI
     00431 00432

CR   AT    BANP        LOUI
     00538

CR   AT    JANP
     00899 00931 01025 01026

CR   AT    KANP
     00496 00515 00993
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CR AT KGPP
00769

CR AT WANP
00428 00429 00430 00518 00757 00912 01152

CR ATBC KANA
01242

CR ATBC BANP CGNP
00727

CR ATBC PC
00595

CR BC AKKI
00786

CR BC NFLT
00691 00788 00789

CR BC OMIN
00343 00344

CR BC BANP
00495

CR BC CGNP
00493 00726

CR BC VAPP
00768

CYE BIM
00714

CYE ID
00951

CYE IDMT
00019 00592 00593 00594 00722 01196

CYE IDMT KONF
00843

CYE IDMT KONF CAB
00154 00157 00719

CYE MT
00295 01072

CYE MT CAB
00559 01160

CYE MT CLAR
01250 01251

CYE MT KOOC
01268

CYE MT YAKR
00907

CYE MT KONF
00105

CYE MT KONF
00345 00720 00733

CYE MT KONF CAB
00158

CYE MT KONF LONF
00294

CYE MT LONF
00420

CYE MT USFS
00296

CYNC MT KONF
00155 01201 01207

CYNC MT LONF
00505 01211

GINF NM GIWA
00292

MEX
00651

NCDE ABM AKKI
00790

NCDE ATMT
00454

NCDE BCMT NFLT
00787 00791 00898

NCDE BCMT GLNP FLNF NFLT
01092

NCDE MT
00116 00117 00125 00188 00189 00190 00245 00262 00263 00301
00302 00327 00356 00456 00468 00534 00540 00541 00547 00548

00553 00556 00558 00560 00566 00567 00571 00573 00585 00586
00588 00616 00668 00705 00707 00709 00713 00728 00729 00730
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NCDE MT ANBU
00555 01041

NCDE MT NFLT
00561 00563 00712 00936 00999

NCDE MT PIBU
00669 00670

NCDE MT RATT
01065

NCDE MT SFLT
00269 00357 00587 00708 00710 00711 00792 01095

NCDE MT SUNR
00121

NCDE MT WGLA
00528

NCDE MT WHR
00552

NCDE MT FLIR
00131 00160 00161 01063 01074

NCDE MT FLIR MCPK
00148 00615

NCDE MT FLIR MISS
00614 01075

NCDE MT FLIR FLNF MISS
01067

NCDE MT FLIR USFS MISS
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NCDE MT FLNF
00064 00516 00584 00734 01203 01208 01281

NCDE MT FLNF HUNG
00143

NCDE MT FLNF MISS
01159

NCDE MT FLNF NFLT
00572 01274

NCDE MT   FLNF   SFLT
00449

NCDE MT   FLNF   SWAN
00020 00146

NCDE MT   FLNF   WHR
00124 00410 00564

NCDE MT   FLNF FLIR MISS
00444

NCDE MT   FLNF KONF
00012

NCDE MT   FLNF LCNF
01128 01129

NCDE MT   FLNF LCNF LSWA
00212 00225

NCDE MT   FLNF LONF
00703

NCDE MT   FLNF LONF BMWA
00704 00706

NCDE MT   GLNP
00142 00340 00498 00499 00575 00576 00579 00581 00596 00597
00604 00607 00608 00735 00736 00737 00738 00739 00740 00741
00742 00743 00744 00745 00746 00747 00748 00761 00762 00763
00816 00819 00863 00870 00996 01144 01145 01146

NCDE MT   GLNP   APGR
00602 00605 00606 00915 01084

NCDE MT   GLNP   CAMA
00995

NCDE MT   GLNP   ELLK
00033

NCDE MT   GLNP   MANY
00031

NCDE MT   GLNP   TWOM
00047 00137

NCDE MT   GLNP BLIR STMR
00032

NCDE MT   KONF FLNF WHR
00409

NCDE MT LCNF
01035 01190 01269

NCDE MT LCNF BACR
01036

NCDE MT LCNF FLNF
00186 00187 01193

NCDE MT LCNF LSWA
01221

NCDE MT LONF RATT
01163

NCDE MT LONF SEEL
00293

NCDE MT LONF FLNF WHR
00804

NCDE MT SLCK
00570

NCDE MT SRGR
00947

NCDE MT USFS LSWA
01220

NCDE MT USFS MISS
00374

NCDE MT USFS SCAP
01150

NCDE MT USFS BLM RMEF
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01042 01212 01213

NCDE MT USFS FLIR
01073

NCDE WY SHNF BTNF
01016

NCE BCWA
01148

NCE WA NCNP
00082 00083

NCE WA NCNP USFS
00084

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NINT NWT               MMTN
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NINT YK
      00928 00929 00930 01119 01271

NINT YK   KLGS
      00922

NINT YK   KLGS         ALSE
      00916 00917 00918 00919 00920 00923

RGNF CO   SJNF SJMT
      00702

SBE  ID
      00241

SBE  ID   CLNF
      00810

SBE  IDMT
      00845

SBE  IDMT BINF NPNF SBWA
      01034

SBE  IDMT USFS         SBWA
      00136

SME  BCIW
      00661

SME  ID
      01277

SME  ID   IPNF
      01149

SME  ID   KONF
      00009 00010

SME  IDWA
      01276

SME  IDWA KONF
      00008

SME  WA
      00913 00914

YGBE ID   TANF
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YGBE ID TANF ASHT
00395 00396 01194

YGBE ID TANF ISLP
00331 00749

YGBE IDMT CENT
00088

YGBE IDMT TANF GANF ISLP
00270

YGBE IDWY TANF
00582 00672 00809 00906 01195 01206

YGBE IMW
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00590 00591 00600 00603 00609 00623 00624 00625 00626 00627
00628 00629 00630 00631 00632 00634 00635 00636 00637 00638
00640 00641 00642 00643 00644 00646 00647 00750 00753 00754
00756 00776 00778 00874 00949 00950 00969 01015 01044 01045
01046 01081 01086 01141 01143 01147 01214 01233 01234 01244

YGBE IMW NPS USFS
00089

YGBE IMW USFS YNP
00016 00799 00800

YGBE IMW YNP
00030 00068 00103 00171 00172 00173 00174 00175 00177 00178
00179 00196 00197 00199 00200 00202 00214 00215 00220 00223
00227 00326 00399 00452 00485 00525 00526 00613 00645 00684
00755 00794 00795 00796 00801 00864 00866 00871 00872 00873
00945 01057 01187 01188

YGBE IMW YNP USFS
00069 00176 00195 00209 00211 00213 00226 00450

YGBE MT BTNF SHNF
01010

YGBE MT GANF
00106 01202

YGBE MT GANF JARD
00107 00687 00840

YGBE MT GANF MADR
00085

YGBE MT GANF SKYL
00633 00798

YGBE MT SHNF BTNF
00011

YGBE MT YNP GALL
00151

YGBE MTWY
00601

YGBE WY BTNF
00152 00511 00512 00855 01199 01209 01210

YGBE WY BTNF TEWI
00162

YGBE WY BTNF SHNF
01014

YGBE WY JDR GTNP
00513

YGBE WY SHNF
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YGBE WY SHNF BTNF
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YGBE WY YNP
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00221 00222 00751 00752 00797 00857 01112

YGBE WY YNP CLCR
00405

YGBE WY YNP FISH
00108 00639 00868

YGBE WY YNP GALL
00150

YGBE WY YNP HAYD
00372

YGBE WY YNP LAKE
00523 00524 00973

YGBE WY YNP PELI
00404 00406

YGBE WY YNP TROU
00522

YGBE WY YNP WHIL
00867

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